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Pesticides And The Environment

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ENVIRONMENT VIEWS

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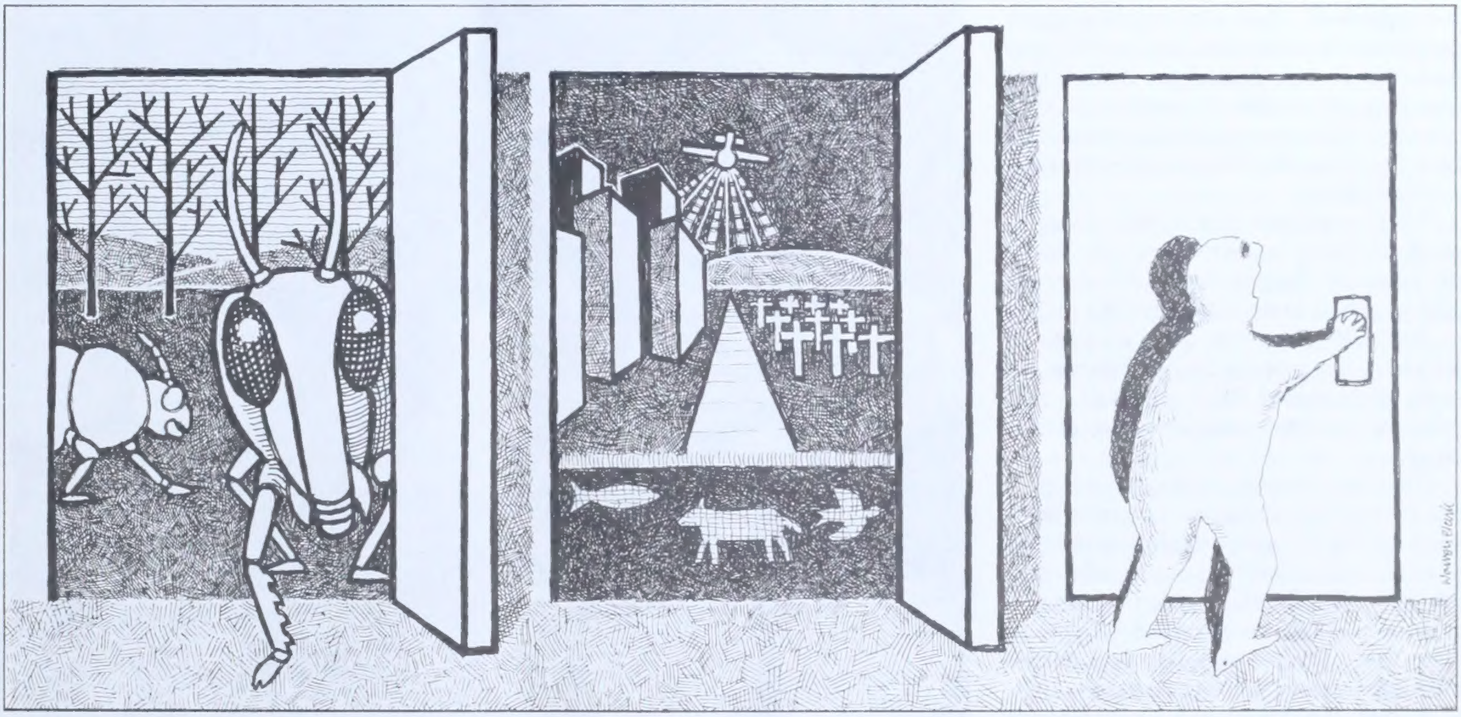
Alberta
ENVIRONMENT

Introduction: **Gillian Sniatynski**

Environmental Impacts Of Pesticide Use

A debit now showing on the balance sheets?



Ants, bedbugs, book lice, box elder bugs, carpet beetles, centipedes, clothes moths, clover mites, cockroaches, crickets, earwigs, flour beetles, houseflies, leaf miners, lice, mosquitoes, silverfish, sowbugs, strawberry root weevils, and wasps.

That's an alphabetically ordered assortment of Alberta's household pests. Others are the Norway rat, the grasshopper, the warble fly. And what about bacterial ring rot, a potato disease officially in the "pest" category in Alberta? To say nothing of crop pests like wild oats, toadflax, green foxtail, and thistles.

To conquer these and other menaces, Albertans annually pour thousands of kilograms of pesticides on or into their gardens, roadsides, fields, lakes, and rivers. The table shows amounts of pesticide chemicals used in Alberta by licensed applicators such as agricultural fieldworkers, aerial spraying operations, professional exterminators, and people hired to clear brush from railway rights-of-way or highway roadsides. But--and it's a significant omission--there are no figures available on pesticide use by two other major user groups--farmers and householders. The figures, if they were available, would likely serve to confirm just how much pesticide use has become part of our lifestyle.

The history of pesticides, as the story on Page 12 indicates, really began with DDT. The chemical that had been sitting on the shelf for decades was found to be a devastatingly effective insecticide.

The May 1979 issue of the U.S. magazine *Environment* quotes entomologist Robert van den Bosch on the revolution which DDT triggered:

"DDT catalyzed an explosive expansion of the pesticide industry. The process was simple: the unprecedented effectiveness of this insecticide and its siblings and successors and their low cost evoked an enormous demand for them. This is turn attracted vast amounts of capital to create the production capacity required to satisfy this demand. The resultant expansion of the pesticide industry was so rapid and massive that it simply steam-rollered pest-control technology. Entomologists and other pest-control specialists were sucked into the vortex, and for a couple of decades became so engrossed in developing, producing, and assessing the new pesticides that they forgot that pest control is essentially an ecological matter. Thus, virtually an entire generation of researchers and teachers came to equate pest management with chemical control. So did the grower, forester, food processor, mosquito abater, home gardener, politician, government pest-control bureaucrat, experiment-station director, farm adviser, and just about everyone else directly or indirectly concerned with pest suppression."

Currently, less than 500 active ingredients make up some 16,000 pest control products registered in Canada. The main chemical groupings of pesticides used in Alberta are shown in the chart on Page 8. Some are highly restricted in their use, and can only be applied by trained personnel; others are available to all of us; sometimes the only difference is in the strength of the main ac-

tive ingredient. And who are the users? People like those described on Page 9. These days, it's a rare household indeed that doesn't contain a can of something to keep tent caterpillars away from the ornamental trees, and something else to use on the summer mosquitoes.

We use pesticides because they kill pests --and kill them, moreover, quickly, easily and relatively cheaply. And we're not only talking about minor nuisances like aphids on the rosebushes. The story on Page 17 points to some of the major benefits, in terms of increased food production and better health, that pesticides have earned for us.

There has, however, been a price to pay. The publication of Rachel Carson's book *Silent Spring* focussed attention in the '60s on some of the side effects of pesticides, notably DDT. Pesticides persisted in the environment and became absorbed in the food chain. Birds like the peregrine falcons described in the story on Page 20 became contaminated with DDT which interfered with their calcium metabolism; females laid eggs too fragile to survive.

With the realization that pesticides were having an effect far beyond what was intended, there came other concerns. How many chemicals were we ourselves ingesting at the end of the food chain? How safe from contamination was the man hired to spray herbicide on a crop? How safe were we all from contamination by that herbicide as it drifted in the air away from its crop target? And what about residues in the soil?

These concerns are well-founded. Under the federal Food and Drug Act, foodstuffs are monitored to check that chemicals don't exceed the levels specified to ensure health protection. But they're there, all right--up to 0.1 parts per million of dieldrin in our apples, lettuce, potatoes, and strawberries, five parts per million of 2,4-D in our asparagus.

A 1974 publication by the Environment Conservation Authority (ECA) notes that pesticides have low to high degrees of toxicity to humans as internal poisons or as irritants to the eyes, skin, and respiratory organs. The report adds that, though manufacturers must by law include on the label specific directions for use, and any needed precautions, "nothing is so safe that it cannot be abused by thoughtless or careless use." A couple of undiluted drops of the active ingredient in one known pesticide, on a man's bare skin, can kill him.

On the subject of pesticides drifting in the environment, another 1974 ECA publication quotes a Canadian Wildlife Services research scientist: "Each year about 27 million acres (about 11 million hectares) of crop land in the Canadian prairies are sprayed with phenoxy herbicides. Of the approximately 20 million pounds (9 million kilograms) of 2,4-D and MCPA applied to crops, considerable quantities can escape to non-target areas. The hazards of herbicide drift to agricultural crops are well recognized as reports of damage to box elder trees, rapeseed, sunflowers, sweet clover, and shelter-belt trees are common. In south central Saskatchewan, for example, it is impossible to find a box elder tree in July that does not show symptoms of damage typical of that caused by 2,4-D."

Pesticides vary greatly in the speed at which they degrade and decompose in the soil. Some modern herbicides become ineffective the moment they touch the ground. But dieldrin has a life in fertile soil of six years; DDT can persist for 25 years. In a 1976 report on pesticide use in Alberta for the provincial department of recreation, parks and wildlife, Louise Horstman (who wrote the story on Page 20) notes that the effect of pesticides on the soil's microflora and microfauna is as yet unknown. These tiny organisms affect plant growth and soil fertility. Pesticides in the soil may also be absorbed by growing plants, which may then be eaten by animals or man.

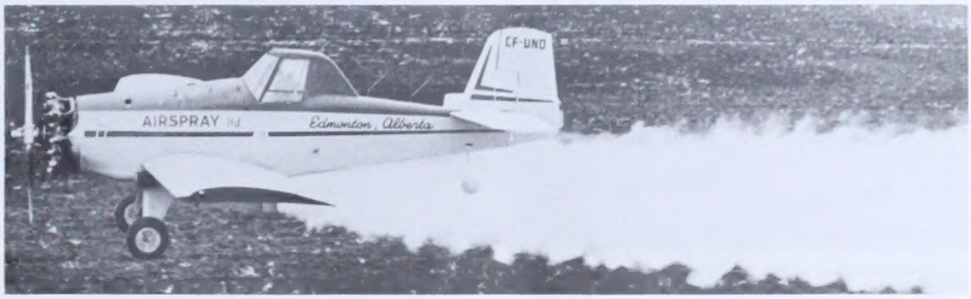
Then there are concerns about the nature of the chemicals themselves and the

	1975	1976	1977
Fungicides	7,125.75	9,742.64	28,644.3
Herbicides	373,873.05	257,032.89	342,524.25
Insecticides	35,014.95	26,473.77	9,657.9
Rodenticides	0.49	81.59	63.45

Total pesticides applied in Alberta by all classes of licensed pesticide applicator (amounts in kilograms of active ingredient)

way they react to other chemicals or outside influences. Sometimes two pesticide chemicals are synergistic--in other words, their combined effect is many times greater than the sum of their individual effects. Horstman notes that a combination of the pesticides malathion and EPN produces a toxicity 50 times what would be expected. Changes may also occur when certain chemicals are exposed to sunlight. One such product is reported to increase its toxicity in this way some 22 times.

Disposal of surplus pesticide chemicals is another major problem. All too often, the disposal site is the nearest water source; the handy slough is where a farmer will wash out the drum that contained his weedkillers, with devastating consequences for many of the slough's life forms.



EDMONTON JOURNAL

All this would be alarming enough even with good evidence to suggest that pesticides are, in fact, the very best way to kill pests. But it's that basic premise that's now getting a severe shaking.

Using chemicals to get rid of an insect pest, say, may also have the effect of killing natural predators of other potential pests. So next year may see a scourge of a different sort. And very shortly after that, the original pest may be back in a new, pesticide-resistant form. Insects are known to be extremely flexible genetically; the few survivors of a chemical blast are able very quickly to reproduce those traits which allowed their survival, and so the species mutates to beat the pesticide. And if another, stronger pesticide is employed, the cycle continues. Current environmental literature calls this process the pesticide treadmill.

Robert van den Bosch, quoted earlier on the fact that just about everybody has come to equate pest management with chemical control, goes on to say:

"In ignoring the ecological nature of pest control and in attempting to dominate insects with a simplistic chemical control strategy, we played directly into the strength of those formidable adversaries. As a result, today, only a third of a century after the discovery of DDT's insect-killing powers and despite the subsequent development of scores of potent poisons, the bugs are doing better than ever, and much of insect control is a shambles."

Fears and uncertainties about pesticide use surfaced in Alberta, and achieved special prominence, partly through the work of the Environment Conservation Authority. The authority had been charged by the provincial government with examining "the expanding federal and provincial policies and programs involving the use of chemical compounds, such as pesticides...which present a threat of serious long-term environmental consequences."

The authority's science advisory committee, under the chairmanship of Dr. David Boag (who writes on Page 28) held technical sessions during 1973 in which experts explored the scientific and technical aspects of the subject. Their findings were presented in a series of information bulletins, designed for the general public. (Some of these bulletins are in fact the "ECA publications" cited earlier.) The bulletins were distributed prior to a series of public hearings held in 1974. After the hearings, the authority compiled its report and recommendations, published in 1976.

That process, as well as identifying many of the concerns already mentioned, produced criticism of the regulatory mechanisms by which pesticides are registered and their use controlled. And many of those criticisms are still relevant. For example:

- The federal Pest Control Products Act and regulations, which govern registration of pesticide products, make no requirement to show that a particular product is actually needed, either to enhance crop production, protect a plant crop or animal group or control a pest situation. The result? A proliferation of identical products made by different companies, and, in some cases, the same product marketed at different strengths under different labels by the same company. There are currently at least 100 different products whose active ingredient is the compound 2,4-D.
- Companies seeking registration of a product are asked to indicate its toxicity to various animal species, and its compatibility with other pesticides. But, says one of the ECA information bulletins, even when registration requirements are specific, industry occasionally submits ambiguous information and government accepts it. The makers of diazinon were asked for information about its compatibility with other pesticides, and government was satisfied with the following vague answer: "Compatible with most insecticides and fungicides; should not be stored in mixtures with copper fungicides but can be used with them in tank mixtures."
- If a pesticide's registration is cancelled, all existing stocks of it must be withdrawn and disposed of (and in the disposal may hang another problem). But a more common occurrence is for a product's registration to be suspended; in this case, no further stocks may be produced. But those in existence can continue to be sold, so harm continues to be done.

Dr. W.G. Evans, a professor in the University of Alberta's department of entomology, participated in the technical sessions which preceded the ECA hearings. He considers the hearing process to have been worthwhile, because it made people responsible for pesticide regulations more aware of the problems. But, he adds, those hearings "didn't solve anything."

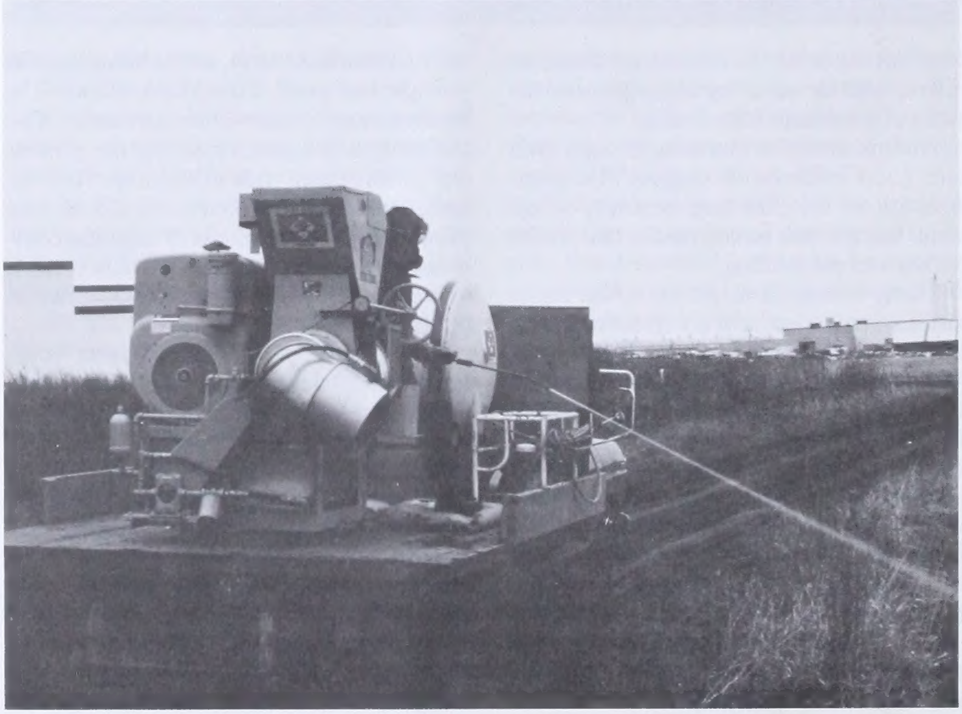
"I almost think we need to have hearings again, the way things are going...

"The new materials coming out still have their problems...There is no miracle material in sight, nothing that will answer the problems. There is a history of banning of insecticides. I suspect that that is going on indefinitely. Materials we are using right now probably will be banned."

There are some grounds for continuing watchfulness, if not discouragement. A recent issue of the American publication *Consumer Reports* concluded that household products containing sodium fluoride, diazinon, and dichlorvos--we have them in Canada too--are too dangerous to be used in the home. Lloyd Peterson, head of Alberta Environment's pesticide chemicals branch, says that scrupulous following of directions should produce few problems with sodium fluoride and diazinon products. But he agrees that dichlorvos products--like the relatively common insect strips--should be avoided by people suffering from multiple sclerosis or other nervous system disorders.

Even the demon DDT is registered by the federal government for some half-dozen uses in Canada.

On the other hand, there are signs of increased attention on the part of government to environmental fears about pesticides. The federal Pest Control Products Act has been tightened. New regulations proposed for the Agricultural Chemicals Act, by which Alberta Environment determines the need for and issues permits for pesticide application and monitors their effects, will, says Peterson, ensure better public protection through tighter controls. The government has just approved a policy for pesticide management in Alberta, intended, as



Pesticide applicators study equipment at a training course (left).
Spraying for mosquito control (below left).
A growing concern–pesticide effects on birds and other non-target wildlife species (below).

ALBERTA GOVERNMENT PHOTO

the document's introduction states, "to ensure environmental protection by effective management of pesticides in the province."

New awareness has produced some effective housekeeping measures. Keith Price, head of Alberta Agriculture's weed control and field services branch, notes that, for example, improved techniques for the spray application of herbicides--using more water to produce bigger droplets, spraying from a lower height, and so on--have reduced drift to one-quarter the former rate.

The chemical companies are making some response to public concerns too. As the story on Page 12 indicates, new products are tending to affect a much narrower spectrum of organisms, and thus cause less environmental damage.

But the story on Page 14 shows just what a laborious and expensive process is the development of new compounds. It's no surprise that, according to one estimate, the odds of getting a new compound on the market are 1:36,000.

In any case, it seems unlikely that the solution to our pesticide dilemma will lie in yet other pesticides. But what are the alternatives?

Biological and cultural methods of pest control, like those discussed in the story on Page 25, look promising. But they, too, can't achieve miracles overnight. A lot of painstaking research has to go on before a disease specific to a particular plant pest can be discovered and set to work; before a hormone stalling the development of another species can be synthesized.

Whether we like it or not, pesticides are going to be with us for some time to come. And as with most environmental issues, their use will boil down to a question of trade-offs.

It's a trade-off situation along the Athabasca River, as the story on Page 23 shows. While some people are expressing concern about the use of the chemical methoxychlor in the river to attack black fly larvae, it's seen as a godsend by local residents for whom black fly is a scourge.

In a sense it's a trade-off situation on many farms, where the high cost of herbicides tends to make farmers favor fewer, broad spectrum products rather than a proliferation of different products for different weed pests. And while tillage is seen by some as a non-chemical means to control weeds, others are concerned about the soil disturbance it entails--and the weed growth it stimulates.

Perhaps the most hopeful light in which to view pesticide use is in conjunction with, not in opposition to, other forms of pest management. The future, say the experts, lies in intergrated pest control, which means, basically, using biological and cultural methods where appropriate and introducing pesticides only where they'll do most good and least harm. Integrated pest control may also mean hitting a pest population when its numbers are low, and using much less of the chemical.

Dr. Dean Struble, an organic chemist at Agriculture Canada's Lethbridge research station, provides an example. He's been working on sex pheromones--the chemicals which a female insect uses to attract the male. Working mainly with species of cutworms, which attack cereal crops, he's been able to synthesize the pheromones and use them as a sort of "bait" to trap and count adult moths and hence estimate the extent of the population in an area. Ideally, if the population is high, farmers can be alerted to the possibility of a cutworm infestation in their crops next spring. They can check their fields early to assess larval damage and decide whether or not treatment is needed. If it is, they can promptly use the most efficient insecticide, having already ensured, thanks to their early warning system, that it's on hand.

For Lloyd Peterson, pesticide use boils down to a need to help nature, because nature, left to itself, doesn't work fast enough for our needs.

By making pesticide registration requirements as stringent as possible, by following application instructions to the letter, by training applicators, and by careful monitoring of effects, we can perhaps make that help a little less heavy-handed.

Gillian Sniatynski is the freelance editor of this magazine.

Coming To Terms

A guide to word meanings,
and the main classifications of pesticides
according to type of chemical compound.

Definitions

***Pesticide**
A chemical formulation used to control or kill non-human organisms considered by man to be pests, i.e., harmful to human interests. Insecticides, herbicides, fungicides, etc. are all pesticides.

Insecticide
A chemical formulation used to kill or control insects.

Herbicide
A chemical formulation used to kill or control plants.

Fungicide
A chemical formulation used to kill or control fungi.

Larvicide
A chemical formulation used to kill or control insects while they are in the larval stage.

Miticide
A chemical formulation used to kill or control mites.

Rodenticide
A chemical formulation used to kill or control rodents such as rats.

**Note: The Environment Conservation Authority, which in 1974 conducted public hearings on pesticide use in Alberta, in fact chose "biocide," literally meaning "killer of life," as the term best describing the effects of chemical formulations in general. The term takes into account the fact that forms of life other than target "pests" are also killed by the chemicals.*

Insecticides

Chlorinated Hydrocarbon Insecticides

These compounds differ widely in chemical structure and activity. They are well known because of their effectiveness in insect control and their relatively low cost. In general, they are persistent compounds that remain for a considerable period on treated plants and in soils and are readily stored in animal body fat (the reason for some environmental problems).

BHC
Chlordane
DDT
Dicofol
Dieldrin
Endrin
Endosulfan
(Thiodan)
Heptachlor
Lindane
Methoxychlor
Toxaphene

Organophosphate Insecticides and Miticides

These are a large group of compounds that range from some of the most toxic to some of the safest insecticides in use today. Unlike the chlorinated hydrocarbons, these compounds are not persistent; they breakdown quite rapidly in the animal body and are not stored in animal tissue or fat. However, successive exposure to small amounts can lead to poisoning. In general, these compounds are unstable in alkaline media, making them unsatisfactory as soil insecticides. Some are plant systemics that are readily translocated within plant tissues; others are animal systemics that contribute extensively to the control of livestock endo- and ecto-parasites. Because of their rapid breakdown there is less danger of residue contamination.

Azinpho-Methyl
(Guthion)
Carbophenothion
(Trithion)
Coumaphos (Co-Ral)
Crufomate (Ruelene)
Demeton (Systox)
Diazinon
Dichlorvos
Dimethoate
Ethion
Fensulfothion
(Dasanit)
Fonofos (Dyfonate)
Malathion
Meta Systox-R
Ronnel (Trolene)
Trichlorfon (Dylox)

Carbamate Insecticides and Miticides

The carbamates are a relatively new group of compounds. These are similar in action to the organophosphate insecticides but are, in general, a safer group with possibly better residual properties. They are more selective in their toxicity to insects than either the chlorinated hydrocarbons or organophosphates.

Baygon
Carbaryl (Sevin)
Carbofuran (Furadan)
Dimetilan (Snip)
Methomyl (Lannate)
Zectran

Botanical Insecticides

Nicotine
Pyrethrin
Rotenone

Inorganic Compounds—Insecticides

Calcium arsenate
Lead arsenate
Paris green
Sodium fluoride

Fungicides

Protective fungicides are applied as sprays or dusts to foliage, seeds, soils, and textiles. Major usage is in agriculture to prevent pathogenic attacks and resultant disease.

Inorganic Fungicides

Copper (copper sulphate)
Mercury (mercurous or mercuric chloride)
Sulphur
Halogens (calcium and sodium hypochlorite)

Organic Fungicides

Dithiocarbamates (organic sulphur compounds), e.g., Thiram, Ferbam, Ziram

Heterocyclic Nitrogen Compounds, e.g., Captan

Carbonyl Compounds, e.g., Dichlone, Chloranil, Formalin

Phenolic Compounds, e.g., Cresol, DNOC

Halogenated and Nitrated Aromatic Compounds, e.g., Chloramine

Organometallic Compounds, e.g., organic mercurials (these are usually more toxic than the inorganic mercurials to fungi)

Herbicides

The herbicides used in Alberta provide a useful degree of selectivity in respect to target weed and the crop involved.

1. Wild oats can be removed selectively from cereal and other crops.
2. Broadleaf weeds can be controlled selectively in crops of grains and grasses.
3. Certain grasses can be controlled in non-grass type vegetation.
4. Complete vegetation control or removal for protection or safety reasons is afforded by still other herbicides.

The herbicide chemicals commonly used in Alberta are of the following chemical groupings:

- Aliphatics
  - Dalpon
  - TCA (Dowpon, Basfapon)
- Benzoics
  - Dicamba (Banvel)
- Bipyridyliums
  - Diquat
  - Paraquat
- Carbamates
  - Barban (Carbyne)
  - Asulam (Asulox)
- Dinitroanalines
  - Trifluralin (Treflan)
- Nitriles
  - Bromoxynil (Buctril)
- Phenoxys
  - 2,4-D
  - 2,4-DB
  - MCPA
  - MCPP (Mecoprop)
- Thiocarbamates
  - Diallate (Avadex)
  - Triallate (Avadex BW)
- Ureas
  - Linuron (Lorox)
- Unclassified
  - Benazolin
  - Endothall
  - Nitrofen

This information appeared in the 1974 ECA information bulletin "The Effects of Pesticide Use on Productivity and Health in Alberta."

Jack Spearman

Let Us Spray

From householders to commercial pest exterminators, most of us do, sometimes.

Don McLean

JACK SPEARMAN

"There is getting to be so many chemicals that farmers would rather employ someone with some knowledge."

Agriculture is the world where pesticide use has really taken off and Don McLean literally straddles tonnes of the chemicals each working day.

He's the pilot of a crop-duster, a short, stubby airplane that's all wings and spraying tank just forward of the cockpit. He swoops down at horseback height and in an average year will spray 16,000 hectares of grain against everything from wild oats, thistles and pigweed to ragweed and buckwheat.

Today's chemicals are different from the ones his father sprayed on the family farm a generation ago. DDT is gone and so are the ester compounds that would mist and blow in the breeze. On the other hand, current products, though perhaps less hard on the environment, may have to be applied twice for the same effect, McLean says.

Most of the chemicals he uses are phenoxy herbicides like 2,4-D or MCPA, bought at dealerships near his Strathmore landing strip.

McLean has a pesticide applicator's licence and has taken annual refresher courses for the past six years. He says brochures from manufacturers also keep him abreast of the latest developments in the pesticide industry along with his conversations with the farmers he flies for.

He says business is good because some farmers are refusing to handle chemicals any more. "There is getting to be so many chemicals that farmers would rather employ someone with some knowledge." McLean says he feels safe around pesticides, noting they are all first approved by the federal and provincial government for use.

He doesn't mix the chemicals that are pumped into the spraying tank--the ground crew does that. But he has gotten a noseful in the past when an unexpected gust of wind blew a cloud of flea beetle spray back towards the airplane. "It was, well, pretty nauseating," he recalls.

He says he has no problems getting the chemicals he needs, that just about anyone could do so if he knew where to go and what to ask for.

McLean's flying is regulated by the province; spraying is prohibited, for example, within 0.4 kilometres of running water. He also has to be careful of wind conditions because the weed-killer used on wheat could kill rape in an adjacent field.

McLean is also a user of most of the pesticides he distributes. He helps farm the family's 1,800 hectares, and has 20 head of Charolais cattle.

Most of the chemicals used on the farm --like the Treflan for wild oats in the rape crops, the Avadex for wild oat control in wheat and barley--are applied aerially. Then there are the 2,4-D sprays for other weeds in the wheat and barley, and a dip (obtained from the local veterinarian) to control warble fly in his cattle.

Larry Beaton

"We are very conscious here about the sensitivity people have about indiscriminate use of chemicals."

The sound of wind whistling through poplar leaves has a certain magic to it, except when the fast-sprouting trees shoot up along 8,000 kilometres of right-of-way for Calgary Power's high-voltage transmission lines.

Fortunately, says Larry Beaton, transmission line maintenance supervisor, only one chemical is needed to solve most of the utility company's vegetation control problems.

"Poplar and maybe aspen are all we have to worry about and 2,4-D is all we

ANDREW VAUGHAN

need for control. In British Columbia and Ontario where there is a greater variety of trees and more hardwoods, a lot tougher chemicals have to be used," he said.

Most of the spraying is done in northern and central Alberta parkland areas.

Calgary Power contracts out virtually all of its spraying along rights-of-way to smaller firms which spray from trucks, and, in tough terrain, from tracked vehicles. Beaton says helicopter spraying is seldom used: costs are much higher and the 2,4-D lands on, and kills, only the tops of trees.

Beaton is fully aware of the sensitivity of more and more Albertans to pesticide use, and Calgary Power remembers well the proposed moratorium on industrial spraying back in 1972. The Environment Conservation Authority hearings on pesticides in 1974 and the formation of the Industrial Vegetation Management Association led to strict procedures on when, where, and how to spray. Beaton notes that Calgary Power also runs regular workshops for sprayers.

He defends 2,4-D as a compound that gets the job done but which has virtually no residual effects. But he points to a change in the way Calgary Power now uses it.

Ten years ago, the company routinely gave a dose of 2,4-D to every tree growing in transmisson line rights-of-way.

"We started to get complaints about the visual impact of brown trees...the funny thing is that the people who did all the complaining were not the landowners over whose property the lines go. It was the city people who went out into the country. Rural folk didn't complain because they know the problems you can have with poplar."

Now, only trees under 1.8 metres are sprayed; the ones which are taller are chopped down even though costs are about 12 times higher.

"We are very conscious here about the sensitivity people have about indiscriminate use of chemicals. So we're much more discriminating in the way we use 2,4-D because quite frankly, it's a tool we want very much to keep on using."

Beaton says the company is frequently accused of using more potent herbicides. But that is only the case where sterilizers are poured into the ground directly beneath the steel transmission towers and in the compounds around electric substations.

Anni Adams

JACK SPEARMAN

"I try not to use anything on the lawn or garden because I'm aware of the old environment."

Anni Adams would as soon pull a dandelion out by hand as give the pesky lawn weed a shot of 2,4-D. She *has* resorted to the popular herbicide, but usually only when winning the home gardener's annual struggle against dandelions seems increasingly difficult.

"I try not to use anything on the lawn or garden because I'm aware of the old environment," she said.

"At least not until something seems to be really wrong."

Adams, a teacher who lives in northwest Calgary, thinks she is more cautious about using pesticides than her mother ever was. "Her generation grew up with DDT and chemicals like that and I think they were less aware of the dangers. Nowadays, we know that problems can pop up 20 years down the road."

The family possesses the standard array of household pesticides: some spray to get rid of leaf miners in the shrubs; a can of Raid used once on a tree after the leaves started to turn yellow; some dandelion killer; and a bottle of insect repellent for camping and fishing. Not much more than $10 worth in a year, says Adams.

She buys most of that at the local Co-op shopping centre--which also sponsored a seminar on lawn and garden care that included tips on pesticides. "They told us how to trim a limb off a tree and the stuff to put on the stump to keep the bugs out," said Adams. "And of everyone at this little talk, I was the only one under 40."

When she does buy pesticides, she says she always talks first with a particular clerk in the hardware section who seems to know what he's talking about.

Adams says most of her friends are also wary of indiscriminate use of pesticides around the house and will try to avoid problems in the garden with insects by such methods as planting garlic around the edge (garlic being a natural insect repellent).

There have never been mouse problems in the house, but if there were, Adams says she would use the tried and true method first: either borrow a neighbor's cat or get some cheese and a trap. "I don't like the idea of putting poison out because there are a lot of kids in our neighborhood and you never know what they could get into."

Adams says she would be even more cautious about using household pesticides if she were pregnant.

Gerry Lebsack

JACK SPEARMAN

"You just don't fool around with this stuff. It's designed to kill and there's simply no room for people who don't know exactly what they are doing."

Gerry Lebsack makes his living with pesticides and has a healthy respect for them.

"As long as you know what you're doing, there's not much danger," said Lebsack, owner of a Calgary pest control service and a director with the Canadian Pest Control Association.

He works with an assortment of pesticides, mainly from the organophosphate, carbamate and botanical families which kill pests by attacking the central nervous system. In the course of a day's work, he might have requests to get rid of everything from silverfish and cockroaches to mice and bats.

There's a bit of a social stigma attached to having a pest control worker visit your home or business. That, says Lebsack, is because Canadians usually don't call him in until there's a problem with pests. Americans, on the other hand, often ask him to fumigate a new house before they move; our southern neighbors see preventive pest control as nothing more unusual than having milk delivered.

"I guess Canadians think having bug problems or mice is the result of dirt or unhealthy living conditions. The truth is that it can happen to anyone no matter how clean."

Lebsack is a licensed applicator and has a diploma in pest management from Purdue University (although post-secondary training is not necessary to get into the job). He says many of his co-workers simply join a firm and go through a sort of apprenticeship over the years.

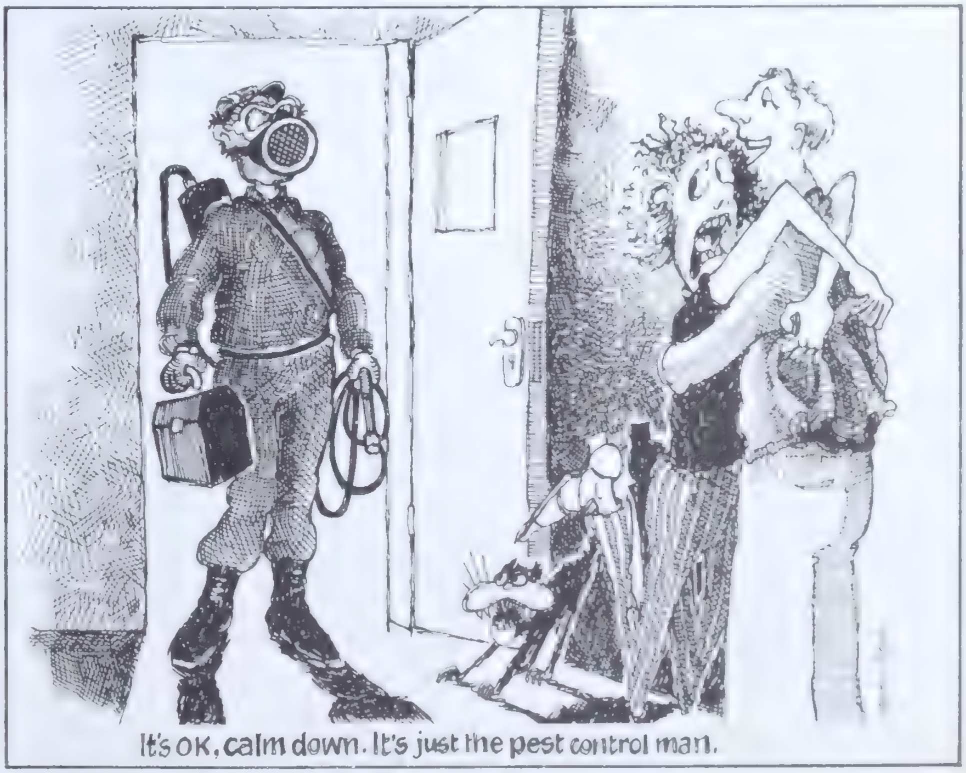
Lebsack is in the process of opening a pesticide specialty shop, the first in Calgary, where customers can get expert advice.

"Most of the time if somebody has a problem with pests they'll just go to a department store and ask the clerk what's best for this or that. All the clerk winds up doing is reading the labels to them."

Lebsack takes appropriate precautions on the job, wearing a breathing mask and gloves when handling the chemicals. "You just don't fool around with this stuff. It's designed to kill and there's simply no room for people who don't know exactly what they are doing."

He buys his pesticides from eastern manufacturers or local supply firms and says just about anybody with enough money could buy whatever they wanted. He approves of current provincial proposals to tighten controls on pesticide purchase and use.

Jack Spearman is a journalist in Calgary



It's OK, calm down. It's just the pest control man.

Maryhelen Vicars

New Weapons In The War On Pests

ANDREW VAUGHAN

LAUREN DALE

Pesticides are becoming more sophisticated and specific in their effects.

Pesticides have come a long way since the days when sulphur, arsenic, coal tar and other "witches' brews" were pressed into service in the age-old battle of man versus the weeds and insects which compete with him for food.

Dick Hebbourn, manager of agricultural research and development for Dow Chemical of Canada Ltd., says the first chemical pest control was a haphazard affair.

"It was more by luck than anything that the weird collection of wonderful things sometimes worked, but people got a feeling of satisfaction from doing something rather than just sitting back and letting the bugs chew away."

Many of the early chemicals used to control insects and weeds did more harm than good.

Hebbourn says that at about the time of the Second World War sodium chlorate was used as a weed-killer. It killed the weeds, but it made the dead and dried vegetation highly flammable. When it was used along railway rights-of-way, a spark from a passing engine was all that was needed to set long stretches of bank aflame.

In the tradition of pounding swords into ploughshares, Hebbourn says, two important agricultural chemicals were first developed in wartime. These were DDT, an early insecticide, and 2,4-D, one of the first herbicides.

Both are forerunners of the sophisticated, highly specific chemicals farmers and gardeners use today.

"DDT did a wonderful job controlling fleas, initially for the troops and later in the war-ravaged cities of Europe.

"Whole segments of the population were waded through big tubs of solution like cattle being dipped, and DDT dust was blown around the houses."

When the Germans were cut off from their sources of fuel during the war, they turned to the production of alcohol from grain, to be used as a gasoline substitute. To retaliate, the Allies looked for a plant hormone which could kill the grain crop.

The phenoxy weed-killers which they developed (called 2,4-D in the U.S. and MCPA in the U.K.) did just the opposite of what they were designed for, Hebbourn says.

They were supposed to kill grasses, but killed broadleaf weeds instead, and promoted stronger, better crops of grain by eliminating the competition.

These chemicals are what Alberta Environment pesticide chemicals branch head Lloyd Peterson calls "first generation" pesticides. Both are broad spectrum chemicals; that is, they are toxic to a wide range of species.

DDT and others of the same type, called organochlorines, are also persistent. They build up in the environment, and in the bodies of birds and mammals.

Also, after some time, strains of insects develop which are resistant to DDT. This resistance, and the environmental problems DDT use entailed, led researchers to try alternate chemicals which led to "second generation" insecticides, the organophosphates. The most famous of these is malathion, made by Cyanamid.

Peterson says organophosphates had

ANDREW VAUGHAN

their origin in wartime too, being first developed as a war gas by the Germans and later found to have insecticidal properties.

These chemicals are more sophisticated than DDT: they are more toxic, so less is needed; and they affect a narrower spectrum of other organisms. Among the organophosphates, for example, one is used for the control of mosquito larvae.

Hebbourn says in low dosages the organophosphates are of low toxicity to mammals, including man. They *are* toxic to man in high doses, but do not build up in the body as organochlorines do, and break down quickly in the environment.

But these chemicals, although in many ways an improvement over DDT and the less effective insecticides which preceded it, are not without problems. Insects can also build up a resistance to them, and if not handled carefully, they are very toxic to humans and animals.

Peterson says DDT is still used extensively in developing countries because the more sophisticated chemicals are too expensive and require special equipment and training to use safely.

But where their use is possible, those new chemicals are sophisticated indeed. More stringent registration requirements are producing products which are becoming increasingly narrow in the range of non-target organisms they affect; the goal is an insecticide which will affect only one, target organism.

Peterson cites the insecticide Altosid as a good example of this trend. The product is a type of growth hormone which prevents adult mosquitoes emerging from larvae--though its effects as yet are not restricted to mosquitoes.

Another new development in insect control is a modern twist to an old technology.

Pyrethrin is a chemical occurring naturally in the petals of chrysanthemums; it was one of the first insecticides used before the development of DDT. Now much research has gone on into the development of synthetic pyrethrins, called pyrethroids.

Pyrethroids are relatively short-lived, relatively toxic to pests and safe for mammals, but Hebbourn says more chemical research is needed in an effort to make them more specific—they kill beneficial insects as well as harmful ones.

Bacterial parasites are being developed which are highly specific against certain pests. One such parasite has been developed against the spruce bud worm, but it has received limited use because of the high cost of its application.

Development of herbicides, as of insecticides, has been from broad spectrum to more specific chemicals. Peterson compares the early chemicals to a shotgun blast which scatters shot widely, the later ones to a rifle shot.

The phenoxy herbicides (like 2,4-D, mentioned earlier), were first used at about the same time as DDT. They are plant hormones which are highly toxic to any broadleaf weeds, but have no effect on grasses.

Later chemicals were developed which would attack specific grasses and leave others unharmed, killing, for example, wild oats in a wheat field, but sparing the wheat.

As well as the use of more sophisticated hormones, Hebbourn explains, modern weed control is partly a matter of careful timing, so that a weed-killer is applied when the target plant is at its most susceptible stage of growth and the plant being protected is at a less susceptible stage.

The energy shortage may force the agricultural chemical industry to develop in new directions, Hebbourn believes.

"We're moving to an energy-short era," he says. "All pesticides are energy-intensive in their manufacture and energy-intensive in their application. A lot are diluted with petrochemicals.

"I'm inclined to think in the next decade we're going to see more efficient use of pesticides and more efficient methods of application." He cites as an example the "gross waste of oil" involved in applying oil-diluted pesticides instead of dust.

Researchers, he says, are now experimenting with a method of applying chemicals in a controlled release form. The chemical is in a capsule which degrades slowly in the field, releasing its contents over several growing seasons. One application can then last several years.

"This saves gas, it saves time and it saves wear and tear on the tractor," he says.

Maryhelen Vicars is a journalist in Edmonton

Susan Mayse

A Chemical Chronicle

LAUREN DALE

It's a slow, expensive journey from laboratory to marketplace

Even dedicated research scientists have their tall tales, at least after hours. One of them is the story of Tordon's discovery.

It seems a lab scientist at Dow Chemical was working with new compounds of unknown properties just before quitting time one day. He carefully put away the chemicals and washed his hands, then went home to dinner and a quiet evening of tending his prize-winning rose garden. A few days later his pampered bushes were dead, but a new compound was causing a flurry of excitement at Dow. The minute amount of chemical lingering in the pores of the rose-fancier's scrubbed hands had been strong enough to kill his roses. The compound was eventually to be called picloram, the active agent in the herbicide Tordon.

Only a story, warns Dow's manager of agricultural research Dick Hebbourn in Sarnia, Ontario. Yet however obscure its origins, Tordon has become a front-line product and has been widely used as a brush killer for nearly 15 years.

Developing the herbicide from its first clash of molecules in a synthesis chemist's test tube to a saleable compound was a slow, arduous and expensive process. Unlike Madame Curie's radium or Dr. Jenner's smallpox vaccine, agricultural chemicals don't sparkle with star potential. Many researchers worked on Tordon from the late '50s on, but no single name stands out. "It was just hard work and dogged determination all the way," says Hebbourn.

Let's get out of here guys...he's wearing his lab-coat.

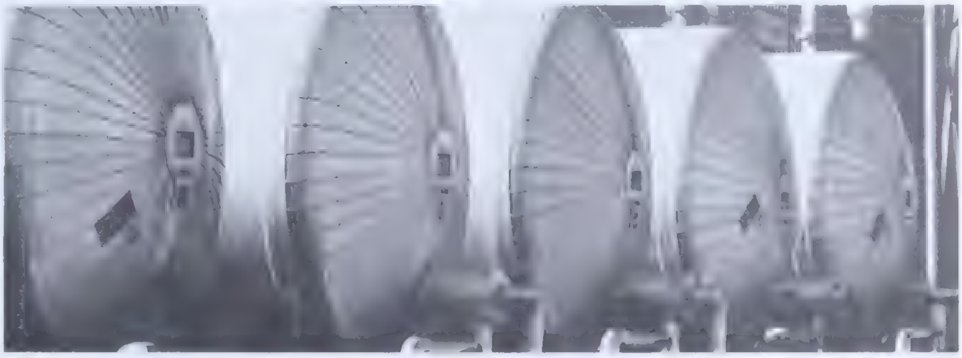
After the fabled rose-grower's disappointment, the compound's next stage was the "first screen," a battery of tests designed to determine whether a chemical is active against different life forms. Tordon turned out to be extremely active against broad-leaved plants but showed a low capability for damaging humans, wildlife, fish, birds or insects. Scientists noted its long-term persistence in soil.

Once it was established as a potential weed killer rather than, say, an insecticide, Tordon was ready for limited field testing. Lab chemists had studied the chemical with a relatively small total amount--no more than about a kilogram altogether--but field applications meant producing enough to spray on different crops, weeds and woody plants.

About three years had already passed since first consideration of the chemical; researchers were now certain of its herbicidal properties, and "had a handle" on its product potential. At this point, Dow could have opted to put the compound back on the shelf as a curiosity that could be forgotten over the years or eventually dusted off for a different purpose. Up to $3 million had already been applied to the first stage of the program, and it was the cheapest part. But instead of setting Tordon aside, researchers sent it to the test plots for field formulation development studies.

The new chemical was tested with a registered weed killer already on the market and having a similar spectrum of activity. When a compound at this stage of testing proves less effective than the known product, chemists put together similar compounds in an attempt to enhance its activity to a level higher than the known chemical's. If it's not possible, there's little point in developing it further. Once again, Tordon passed with flying colors. Like other substances, though, it was found to have a synergistic effect when combined with the existing herbicide 2,4-D; together they were stronger than either chemical working alone.

Other discoveries emerged from the four years of field testing: the compound was safe



L.A. BENTAL

for humans to handle although specific application methods were needed to ensure safety and proper results. Scientists knew exactly which plant species were damaged, and how much of the chemical was needed to get the intended biological effect.

Three other major test programs ran concurrently with the field tests. Advanced in-depth toxicology studies attacked the new compound from many angles to gauge its effect as a poison. What happened when dogs had a steady diet containing the substance for two years? Would the compound cause skin damage on contact? How did birds react when the chemical was introduced into part of their food chain? Would fish perish if the compound found its way into their body of water? Under painstaking study, Tordon cleared all hurdles.

"These were exaggerated tests, designed to indicate any potential problems," says Hebbourn.

Residue programs were taking place at the same time. If the weed killer were applied to a wheat crop, would harmful residues linger to be baked into loaves of bread? Not in Tordon's case, it turned out. (Sometimes this test results in a warning on a pesticide label--"product not to be applied within 30 days of harvest.") However, Tordon's active ingredient picloram did linger in the soil to affect following crops--for up to five years in cool dry climates like our own or as briefly as one year in warm wet areas.

"Tordon grows lovely grass or wheat," Hebbourn assures. "But if a farmer wants to control thistle in his wheat and then rotate to a broad-leaved crop, he just can't use Tordon. He'll have to find another way to control weeds."

The third battery of tests running concurrently were environmental impact studies. These examined the practical effects on non-target species. Years of lab work may produce an excellent insecticide to control army worms, for example, but it won't be useful if it also wipes out a beeyard's hives.

There is some overlap between these programs, but the time and money they take are necessary to satisfy a government that a new compound can safely be registered for sale and use.

"Agricultural chemicals are more highly tested and regulated than any other product," says Hebbourn. "Drugs are only tested for the effect on human life, but with pesticides that's only one aspect tested."

After this second stage of testing and developing Tordon, all findings were collected and put into the format required by Agriculture Canada for its own evaluation. The department decided on the basis of these findings--some of them corroborated by government or independent study--that the new compound performed the intended function, that there was a need for it on the market, that farmers or others would benefit and that it was safe enough to use. But further testing was indicated, by both Dow Chemicals and Agriculture Canada.

By now it was clear that Tordon was most useful as a brush killer for woody areas such as power-line right-of-ways and for controlling woody perennials and weeds in rangeland and permanent grass pastures. Western Canada was the obvious place for further study, and both Alberta Agriculture's research station at Lacombe and Agriculture Canada's Lethbridge research station took part, backed up by other testing at Olds College. All this filled in details of Tordon's overall effect, but essentially confirmed the original findings. Tordon was registered in Canada in 1965, after seven years of research at a cost of about $15 million.

Meanwhile, other countries were carrying out their own test programs on the new chemical. The bulk of the work, by Dow Chemical or under the auspices of government, was in the United States. Two United Nations agencies, the Food and Agriculture Organization and the World Health Organization, also looked into it. Several countries had already approved use of the new herbicide under their less rigorous regulations; Hebbourn recalls British Rail was applying it for weed and brush control as early as 1963.

"Canada probably has the best and most responsible regulatory controls in the world," Hebbourn says with approval. "The programs are similar in the United States, but Canadian inspectors and regulatory people are very much better--we're not prone to lobbying or arbitrary decisions like the Americans."

Yet the process of testing, re-examining, and reviewing chemicals in the light of new technology or new concerns goes on long after registration. Generally it's demanded by government or by a chemical company itself rather than by public reaction, which rarely has a direct effect on product development.

"Public response gives us concern and it

LAUREN DALE

costs us a lot of money. Agriculture is going to go on irrespective of whether people raise a hue and cry or not. Right now we're living in a time of plenty, and the population accepts good clean high-quality food. If agricultural chemicals are forced off the market, it's going to hurt the productivity of our farms, the cost of food and the variety of food. People would soon be screaming again for good and cheap food," Hebbourn says. He cites a Manitoba study estimating the cost of grain would double if no pesticides were used in its production.

If safety is a rallying cry for activist groups and pesticide manufacturers, it's also a prime concern to provincial governments, and Alberta has one of the strictest regulatory legislations in Canada. Provinces have the option of adding their own restrictions to the federal codes, though they can't in any way diminish them. Only British Columbia and Ontario have stronger laws on agricultural chemicals, says the head of Alberta Environment's pesticide chemicals branch, Lloyd Peterson.

Pesticides, including Tordon, are governed by 14 different acts of the Alberta government. A further 11 federal acts apply directly to pesticide use in the province.

"The federal acts aren't administered by the province, but our own legislation must dovetail to conform to them," says Peterson.

Alberta, like B.C. and Ontario, also requires people applying pesticides for hire or as a service to hold provincially-issued licences. The applicators must take a training course to receive a licence.

"We try to protect the environment as a whole against abuse. Ninety-five per cent of people don't need laws, but we have a smaller element that's out to do something unfortunate for economic or who knows what gain."

Today, Alberta Environment gets involved with a new pesticide while it's still undergoing research. After a chemical's data sheet--based on lab tests--has met the approval of federal agriculture, environment, and health and welfare departments, Agriculture Canada gives a research permit to carry out further tests beyond the lab walls. If research is to be located in Alberta, the province issues its own research permit unless a government office or the University of Alberta will be handling the study. Then tests are undertaken by Alberta Environment staff in the early stages, monitored by the department or carried through by independent researchers in addition to ongoing manufacturer's tests.

"We're limited in the number of people we have to make evaluation of some of the test sites and research," explains Peterson. "We hire outside people from the University or elsewhere to evaluate the substances at work."

With many thousands of chemical compounds--including household and water or forestry chemicals--under its jurisdiction at any given time, Alberta Environment can only keep an eye on tests of compounds still far from registration, and concentrates on those with more immediate licensing potential.

"If we were talking about a chemical used on oats and barley, we would monitor the effect on the milk of cows," says Peterson.

"With Tordon it's a different matter. Picloram doesn't produce a measurable quantity of effect in humans or animals, so we monitor the soil, water, and plants by chemical analysis."

Monitoring and testing by the department, like Dow's own research, goes on long after a compound has received its nod for registration by Agriculture Canada and appeared on the market. Registration can be cancelled if further testing shows a product is unsafe or ineffective, as in the case of a widely-advertised home insect control device--it's now sold without a registration number, and shunned by the wary buyer. Other chemicals may have a change of registration, which restricts their use or method of application. There's no statute of limitations for the pesticide business; a product may be reviewed and receive changed status at any time. And the surveillance doesn't begin and end at registration.

After seven years in research and 15 in general use, Tordon remains a profitable and respected Dow Chemical product. Yet few agricultural chemicals have been developed since.

"Numbers peaked in the late '60s," Hebbourn says. "Then they dropped off dramatically."

The reason is simple: cost. Seven to 10 years and $15 to $20 million are just too much to risk against the likelihood of recovering the investment from sales. Canadian and American patents are issued for a 17-year span. If 10 years are used in research, it leaves a fleeting seven years to make money on the compound.

"From the industry standpoint, it's often questionable wisdom to place such demands on the chemical. We have to look at the risk-benefit ratio. If the compound would have to be used at an unrealistically high toxicity level, then is it worthwhile to develop it?"

So if another research chemist wanders home from the lab one day with enough of an unnamed chemical under his fingernails to kill every aphid for miles, it may just remain a mild curiosity among his colleagues.

Susan Mayse is a freelance writer living in Edmonton.

Sharon Adams

In some cases, pesticide use may be

The Lesser Evil

The world's most-read history book, the Bible, lists the endless nightmares daily confronted by inhabitants of the pre-pesticide world. Not only were there natural disasters and storms to claim crops and lives, but locusts, plant diseases, winged, legged and stinging pests drove sufferers nearly insane, and plagues and illnesses of then-unknown cause decimated popuations.

Pesticides may boost productivity and save crops from infestation.

ALBERTA GOVERNMENT PHOTO

The need to develop highly productive and specialized crops to feed a burgeoning population and free man from some of the vagaries of nature lies at the heart of today's extensive pesticide use.

Although there are legitimate concerns about the long-term effects of pesticides used to control weeds, bugs, worms, rodents, and fungi, there can be no argument that without pesticide help, our way of life, and death, would be vastly different.

In a 1974 report on the effects of pesticide use on productivity and health in Alberta, the Environment Conservation Authority (ECA) noted some significant benefits derived from pesticide use, chiefly improvements in human health and food production. For instance, it reports that during the last 30 years, more than a billion people around the world have been freed from the threat of malaria.

Developments in medicine and pesticides have increased the life expectancy, and thereby the population, on a global scale. That population increase has put a tremendous strain on the world's ability to produce enough food, for most of the world's arable land is already under cultivation. The task is to coax ever more food from the land already in use. That's where pesticides come in.

In Alberta, the ECA report states that without pesticides, at least six million more hectares of land would have to be farmed to produce the same amount now reaped with the help of chemicals. Those chemicals are used to control the 2,500 species of insects, innumerable plant diseases, 50 species of worms, and 1,000 weed species, either potentially harmful to, or competing with, crops, livestock and humans.

Bruce Stewart, head of the treatment and enforcement section of Alberta Environment's pesticide chemicals branch, estimates agriculture here employs only about five per cent of the population, compared to 80 per cent in underdeveloped countries, where more human energy is spent in weeding crops than in any other activity. Pesticides, as well as technological developments, have freed most North Americans from the land to pursue other careers, thus diversifying the economy.

Elmer Allen, an economist with Unifarm, says Alberta farmers produce between five and 10 per cent more from their fields with the help of pesticides, and during infestations of weeds, insects, or disease, pesticides may save crops and livestock that would otherwise be lost.

Accurate statistics are not available for overall economic benefits of pesticide use to agriculture, but there are examples of isolated cases where pesticides have prevented loss:

- Hugh Philip, entomologist with the provincial agriculture department's plant industry laboratory, says an outbreak of flea beetles this year claimed 10 to 20 per cent of untreated rape crops. He reports minimal damage to treated crops, and the protection cost merely 24 cents per hectare; he estimates for every dollar invested in flea beetle control, farmers reaped $30 in crops that otherwise would have been destroyed.
- Cliff Barrett, animal pest control supervisor for Alberta Agriculture, reports $100,000 yearly is spent on the Alberta rat control program, but savings in agri-

Warble control spraying in the Leduc area

Bertha army worm, adult form

ALBERTA GOVERNMENT PHOTO

culture and property damage are between $20 and $30 million. "Rats eat about 50 pounds of produce a year, but defile 10 times what they eat. Also, it's estimated 25 per cent of fires of unknown origin are caused by rodents who gnaw wiring."

- The ECA report states that livestock infested with warble flies, cattle grubs, black flies, or mosquitoes fetch as much as $20 per head less on the market. Philip says livestock pests not only affect an animal's weight gain, lower milk production, interfere with breeding, and mar appearance, but also weaken the animals so they are susceptible to other diseases.
- In the 1930s, only 10 per cent of Alberta's slaughter cattle were graded choice but today, with widespread pesticide use to control livestock pests, 75 per cent are choice grade. Before Alberta adopted a warble control program, between 60 and 70 per cent of the cattle were infested with the grubs, but that total has dropped to between 20 and 25 per cent.

Grasshopper

- In 1934, 900,000 hectares of Alberta farm crops were saved from grasshoppers through use of nearly 15 million kilograms of arsenic; in 1971-73, Alberta farmers saved 90,000 hectares of rape by spraying pesticides, at a cost of $1.50 per hectare, to control bertha army worms.
- In the 1890s, between 10 and 20 per cent of the country's oats and barley crops were lost to smut. Today's losses range between one and two per cent.

Dr. N.E. Borlaug, who won the 1970 Nobel Peace Prize for his work in plant breeding, underscored the role of pesticides in human welfare when he said: "If agriculture is denied the use of pesticides and fertilizers, then man will be doomed, not by chemical poisoning, but by starvation."

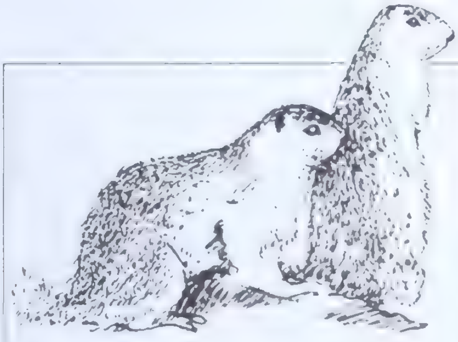
Unifarm's economist Allen agrees.

"The average Canadian doesn't even think about the number of diseases or pests which can harm food supplies. We have a choice of eating wholesome food treated with pesticides, which became ineffective and harmless within as little as days or weeks of use, or eating food contaminated by pests.

"Also, you can't underestimate the value of pesticide use after the food is produced, either to lengthen the amount of time it can be stored or reduce the amount of pest contamination before use. In India (where this type of pesticide use is uncommon), up to one-third of the food produced is consumed by rats."

In Canada, the amount of residue in food is controlled under the Food and Drug Act. Dr. Henry Hurtig, pesticide research co-ordinator for Agriculture Canada, in a 1963 appearance before the Special Committee of the House of Commons on Food and Drugs, said, "The amount of food detained, treated, or refused entry into Canada due to insect infestation, contamination with insect filth or parts, rodent damage, rodent urine or droppings is far greater than the small number of violations arising from excessive pesticide residues. The present system of commercial storage, processing and distribution of food and fibre products would be virtually impossi-

Examining a cutworm infestation



Richardson's Ground Squirrel

ALBERTA GOVERNMENT PHOTO

ble without pesticides."

He went on to say that a loss of quality would cause a corresponding price hike to cover losses incurred when housewives refused to buy damaged food, and as a result, national dietary standards would suffer.

But keeping dietary standards high is not the only health benefit accrued through pesticide use. Eliminating many of the pests that prey on man and his food source also eliminates some of the diseases suffered.

Alberta, reports Stewart, has pesticide control programs to deal with the sporadic outbreaks of western equine encephalitis, which can be spread to humans and is highly contagious; Rocky Mountain spotted fever, spread to humans by ticks; and dog, cat, and human fleas and lice which can spread diseases such as typhus.

"A bedbug must feed six times before it reaches adulthood," Stewart notes. "If it's located in a motel, that means it could bite five different people and spread bacteria from one to the other."

Barrett, of Alberta's rat patrol, says poisoning the rodents with pesticides prevents the spread into Alberta of sylvatic plague, which annually claims a few victims in the United States.

He says there is a belt of colonies of meadow voles, Richardson's ground squirrels and pack rats which runs up the Palliser Triangle, the semi-arid expanse of land extending from Mexico to the Canadian prairies. These colonies are hosts to a type of flea which sporadically carries the plague. In their migration, rats often hole up in the infested colonies before moving on to cities and farms, carrying the disease, which is similar to bubonic plague, with them.

Alberta's last recorded plague death was in 1948. The victim was a man who fed his mink with infected ground squirrels.

But aside from plague, keeping rats out of the province prevents them from spreading some 17 other diseases they can communicate to man.

Stewart also reports health benefits gained by the province's innumerable hay fever sufferers from weed control spraying done by counties. Although the program was designed to control weeds along roadsides to prevent their spreading to nearby crops and to lessen danger from fire should they ignite, such spraying also reduces the number of ragweeds and pollen-producing plants which so irritate hay fever victims and other persons with allergies.

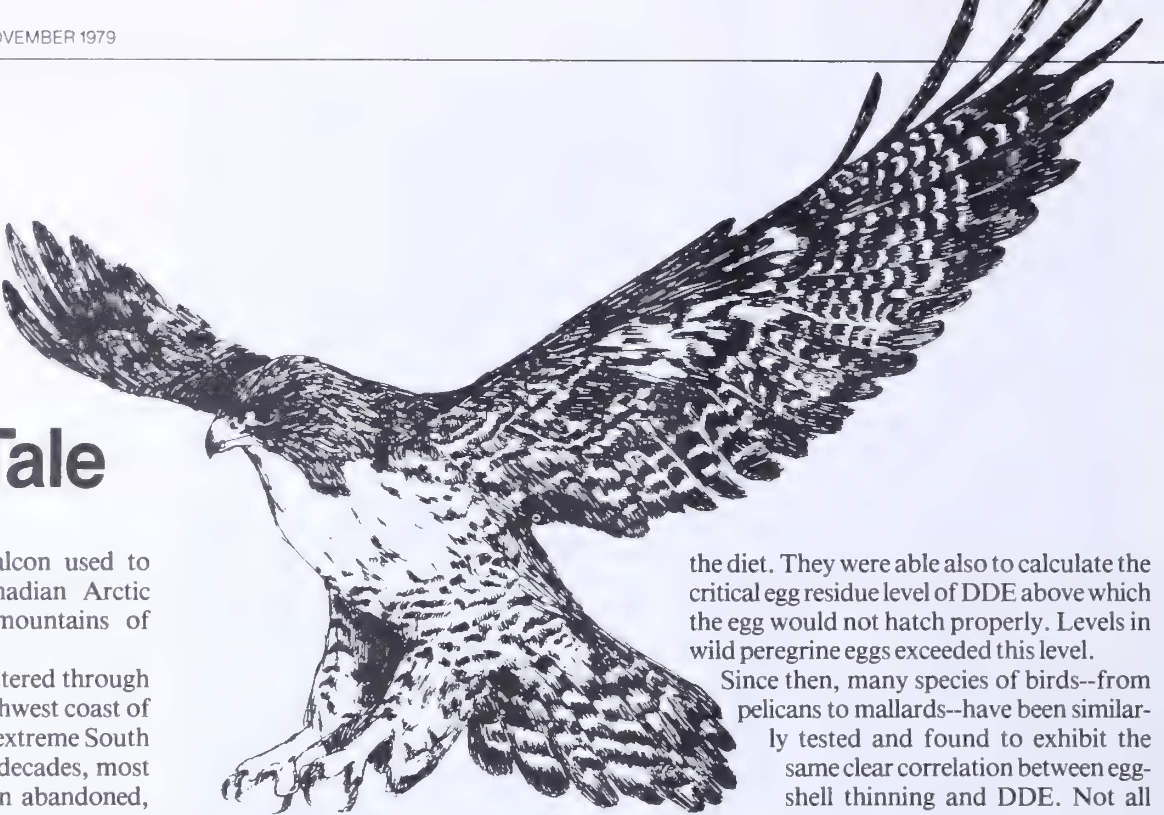
In addition, eliminating bothersome pests allows people to enjoy their backyards and recreation spots such as lakes and cottages, thereby increasing mental, as well as physical, health.

Although the southern part of the province, due to a hotter, dryer climate, is relatively free from mosquito and black fly harassment, in Edmonton it poses a major problem to enjoyment of life in the summer.

Ray Wing, Edmonton's pest control officer, says the city uses about 67,500 kilograms of a 2.5-per-cent, low-concentration, pesticide to eliminate mosquitoes in the larval stage.

Sharon Adams is a journalist in Calgary

Louise Horstman



A Birds' Tale

It has a moral, and a *fairly* happy ending.

The sleek peregrine falcon used to breed from the Canadian Arctic south through the mountains of Mexico.

Today a few pairs are scattered through the Arctic and along the northwest coast of Canada. And some occur in extreme South America. But in a matter of decades, most of the former range has been abandoned, and falcon numbers have dropped markedly.

The plight of the peregrine falcon has come to symbolize what can happen when man introduces a long-lived chemical with an affinity for biological material into the environment.

The chemical in this case is one that we thought we were rid of by now--DDT. Highly restricted in Canada since November 1969, slightly earlier in the U.S., DDT is no longer the source of concern to biologists that it once was--or is it?

Almost every beginning biology textbook relates the DDT story: how DDT is stored in the fat tissue of animals and passed up through the different levels of the food chain with the result that the top predator species may possess in its tissues thousands of times the DDT concentration in the lowest organisms in the chain.

The peregrine, like all birds of prey, resides at the top of a food chain. On the level immediately below it are ducks, gulls, and shorebirds primarily. Below them are snails, clams, and a host of other aquatic and terrestrial invertebrates. Somewhere, below the level of the shorebirds and waterfowl, DDT enters the chain. What are the consequences to the peregrines?

It was in 1965 at an international biologists' conference that the large-scale peregrine population decline, encompassing North America, the British Isles, Western Europe, and Scandinavia, first became widely recognized. Unusually high numbers of broken, unhatched, and missing eggs and abnormal nesting behavior were the most apparent reasons for the decline. The eggs were suspected of being thinner than normal.

What was "normal"? Fortunately, collections of peregrine falcon eggs from pre-Second World War years were housed in museums and collections throughout the world. These were made available to researchers, who found they were indeed thicker than recent eggs.

In Britain, the peregrine population decline had spread gradually from south to far north, much like the usage pattern for the organic pesticides developed during the Second World War. Following up this clue, biologists examined the levels of organic pesticides in the peregrine eggs. They found that the thinner the shell, the higher the amount of DDE--a breakdown product of DDT--in the egg.

This was highly suspicious. But it didn't really prove that DDT was the culprit.

Subsequent studies using captive birds on carefully controlled diets did. Using a common relative of the peregrine, the American kestrel or sparrow hawk, biologists were able to show that eggshell thickness varies according to the amount of DDT in the diet. They were able also to calculate the critical egg residue level of DDE above which the egg would not hatch properly. Levels in wild peregrine eggs exceeded this level.

Since then, many species of birds--from pelicans to mallards--have been similarly tested and found to exhibit the same clear correlation between eggshell thinning and DDE. Not all species are as sensitive, however, as the birds of prey; the domestic chicken, for instance, shows almost no effect.

If DDT was the cause of the decline in peregrine numbers, the restriction on its use in North America could be expected to result in a recovery in numbers. In Britain this did in fact happen. But not in North America, Scandinavia, or Western Europe. The difference is probably due to migration habits. The British peregrines do not migrate far; they encounter only British pollution. In the other countries the peregrine populations migrate extensively. Banded Canadian peregrines have been found in Central and South America, where DDT is popularly used today. Many of their prey species also spend the winter in Latin America.

Thus DDT levels in the peregrine have shown little or no improvement. The North American subspecies, *Falco peregrinus anatum,* might well be on its way to extinction, were it not for the latest chapter in the continuing saga.

The setting: Wainwright, Alberta. In a cluster of large outdoor and heated indoor pens and a trailer or two, known as the Canadian Wildlife Service raptor breeding facility, peregrines and closely related species are raised, encouraged to breed, and monitored over closed-circuit TV. The ultimate aim of this exercise is to reintroduce the peregrine into its former territory. The project is being run by the Canadian Wildlife Service with the assistance of the Alberta Fish and Wildlife Division.

Many people thought the difficulties of the task would prove insurmountable. For one thing, it entailed making the captive falcons feel at home enough to breed. The biologists had to learn the language of bird be-

Peregrine falcons, adult and young (also on Page 22)

havior. For example, some of the pairs put together to mate didn't like each other very much. The sooner the biologists realized this, the better! Secondly, to boost peregrine production, they had to find an incubator regime that would hatch the eggs. For this and all the methods that had to be worked out, other related species were used for experimentation first.

And lastly, how to release the young birds safely into the wild? Where a peregrine pair is already residing, it can be induced to adopt additional young if the pair's own eggs are removed at the right time. In such a situation, the pair simply builds a new nest and lays more eggs. When the original eggs are hatched in an incubator and returned to the first nest, the adults assume parental responsibility for both nestsful.

But in places where no wild peregrines reside, other methods must be used. One is "hacking," which involves providing less and less food for the yound bird so that it gradually learns to fend for itself. Young Wainwright-raised peregrines have been successfully hacked from buildings in Edmonton.

Bands from some of the Wainwright-raised and released peregrines have been returned from Mexico, Honduras, and Colombia, with explanations in Spanish such as "shot by accident." But others--at least four identified for certain--have returned to northern Canada and reproduced.

Richard Fyfe, the peregrine project's director over its nine years of existence, says the stage has now been reached where a substantial number of peregrines--perhaps 40 --can be released into the wild each year. Birds from Wainwright have already been sent to many provinces.

But is the environment ready to receive back its own? The captive-raised peregrines that have been released and returned to Canada to breed are becoming heavily burdened with DDT, to the extent that after about four years of age their reproductive career is at an end—their eggs become too thin, or their reproductive behavior too abnormal.

It remains to be seen when the DDT level will decline. In the meantime, the genetic information for *Falco peregrinus anatum* is being carefully preserved.

The mercury story in Alberta has a happier ending.

Mercury in many forms is an excellent killer of fungi. When cereal and other seeds are coated ("dressed") with a compound containing mercury, they are safe from such fungal diseases as smut and bunt, which can cause seeds to rot after planting. Seed dressings containing mercury were first used in Canada in 1929 and became widely used on the Canadian prairies during the 1950s, when a liquid rather than a powder form of dressing became available. The liquid form consisted of a derivative of mercury known as alkyl mercury.

It took a Norwegian biologist, who had been looking at the effects of alkyl mercury on wildlife in Sweden, to alert Canadian biologists to a potential danger: seed-eating birds might be picking up harmful amounts of mercury from treated seeds on the ground. In Sweden, many dead birds had been found poisoned by mercury. By the late 1960s the source of the mercury poisoning in Sweden had been definitely traced to the alkyl mercury seed dressings.

The Canadian Wildlife Service took note, and in 1968 began sampling seed-eating birds, rodents, and the eggs of predatory birds. Mercury, like all heavy metals, accumulates in the liver. So liver mercury levels of birds collected from an area where treated seed was generally used (southern Alberta) were compared to levels in birds from an area where treated seed was not generally used (southern Saskatchewan). The seed-eaters in the treated areas had significantly higher mercury levels than those in the untreated areas. Pigeons, horned larks, ring-necked pheasants, and Hungarian partridge, all fond of agricultural seeds, showed the highest mercury levels.

More game birds were sampled in Alberta the following summer. Mercury concentrations in the muscle of the pheasants and Hungarian partridge ranged from 0.1 parts

per million (ppm) to 0.8ppm, containing on the average 0.45 ppm. This level exceeded the 0.1 maximum allowable level set by the federal department of health and welfare for commercial food.

These results appeared in late summer of 1969. Special pesticide committee meetings were quickly convened. In September, the hunting season for upland game birds was declared closed by the minister of lands and forests. Would-be hunters and alarmed citizens phoned the government in droves.

That fall, only Fish and Wildlife personnel shot game birds--382 of them--for further mercury analysis. Surprisingly, when the results came back, only one in 10 of the birds exceeded the 0.1 ppm level. Had the previous results been incorrect?

The puzzle was soon pieced together in the light of feeding studies on chickens. Alkyl mercury breaks down in the muscle tissues, with about half of it gone in about 20 days. From the crop contents of the game birds collected it was learned that the agricultural--hence treated--seeds were eaten mainly in late spring and early summer. By September, then, most of the mercury in the muscle would have disappeared.

The Canadian birds had not been found dead, as birds in Sweden had been. But studies on penned pheasants in 1969 showed that a reduced hatching rate could result from the levels of mercury in the wild Alberta pheasants. Prairie falcons and merlins (pigeon hawks), both of which feed primarily on seed-eating birds, also had egg residue levels high enough to suggest a reduced hatching rate. These birds were undergoing localized population declines on the Canadian prairies.

As Richard Fyfe of the Canadian Wildlife Service points out, it was fortunate, in one sense, that the mercury showed up in a game species. How many people would care whether the prairie falcon was having reproductive failure, compared with those who would get upset when they couldn't go hunting?

1970 saw the beginning of the phasing out of mercurial seed dressings in Alberta. Seed treatments declined by 42 per cent that year, and the game bird hunting season was reopened. In December, 1970, the manufacture of mercurial seed dressing was prohibited Canada-wide. For the next two years the mercury levels in prairie falcon and merlin eggs dropped steadily, levelling off at a constant figure after 1972, according to Fyfe.

Both the DDT and mercury stories have been oversimplified by one major omission: these were not, and still are not today, the only chemical residues found in birds. PCBs, dieldrin, hexachlorobenzene, heptachlor epoxide—these are some of the chemical names seen time and time again in tissue residue analyses of all kinds of biological material, from fish to birds to milk. Nobody knows what effects they have, if any, or whether together in combination they may exert some additional effect. It seems reasonable to assume that at least some of them are putting some kind of stress on the organism, and that there is likely some level above which the camel's back, or, more aptly, the bird's shell, will break.

Louise Horstman is a wildlife biologist and freelance writer living in Edmonton.

Gillian Sniatynski

The Black Fly Takes Some Beating

Methoxychlor is a chlorinated hydrocarbon insecticide, of the same family as DDT. Like DDT, it is not specific to any one species, but can affect a broad spectrum of other organisms.

Simulium arcticum is the species of black fly that attacks livestock in the northeast part of Alberta's Athabasca county. Bites from the blood-sucking fly can cause toxemia, especially in imported animals that haven't developed a resistance to the insect; affected animals may go into shock, and die. Particularly susceptible are newborn calves, and bulls, whose breeding capacity may be reduced or delayed.

Simulium arcticum has been described in one research report as the only species on the western Canadian prairies, and perhaps in all of Canada, known to kill livestock by direct poisoning. Even where animals recover from their bites, weight loss and lowered conception and milk production rates are almost invariable consequences of a black fly outbreak.

This year, as for several preceding years, methoxychlor was applied to a stretch of the Athabasca River known as a black fly breeding area. The intent was to kill off black fly larvae in the river. The decision to try chemical control, and the choice of that particular chemical, are the latest steps in a battle with the black fly that has gone on for decades.

Farmers' complaints about the problem date back to the 1930s. But Joe Gurba, head of the crop protection and pest control branch of Alberta Agriculture's plant industry division, recalls that the first formal steps were taken towards control of the pest in 1962.

And nobody is enjoying the fight.

Complaints in that year prompted the county's agricultural service board and the district agriculturalists to combine forces and make a survey of black fly damage in 1963.

Then in 1967, Dr. K.R. Depner, an entomologist at Agriculture Canada's Lethbridge research station, was asked to mount a research project into ways of controlling the pest.

"In 1968 I started out with a student assistant and a very small boat," he recalls. The first year was spent investigating breeding sites. Then in the following four years, work focussed on the nature of the Athabasca River, an aspect of the research which was to be particularly important when the time came to apply chemicals.

In 1973, the decision was made to set up an experimental feasibility program. Scientists from several federal and provincial government agencies and the Alberta Research Council took part and the first methoxychlor treatments began in 1974.

In other areas, chemicals had been deposited into rivers from bridges or rafts.

"I felt that technique was not precise enough," Depner said. "So I developed a boat application technique. We used power boats as platforms to carry drums of materials. The stuff was put in where the constant flow was apparent, and in a very precise pattern. The river was divided into sections depending on the rate of flow, so we got our mixing much quicker."

The same technique was used in 1975 and 1976. In a follow-up study in 1977 no treatment was applied.

The program's objective--control of black flies--was successful enough to warrent a resumption of treatment this spring, with the county's agricultural service board, funded by Alberta Agriculture, doing the application, and Alberta Environment monitoring the operation.

As far as the farmers in the area are concerned, strong measures are essential.

Gurba recalls that the people in the county were prepared to use DDT themselves before the research program got under way. According to county reeve Lee Melsness, local residents strongly support the methoxychlor treatments.

Himself a farmer, Melsness says he expects one of his horses to lose the sight of one eye as a result of the latest outbreak.

"There are various occasions each summer when someone loses animals, especially cows and bulls," he said.

"One of the biggest losses is in nonproduction of animals. They don't seem to go through the breeding cycle."

During the 1972 black fly outbreak, both beef and dairy cattlemen within a thousand-square-kilometre area north and east of the town of Athabasca were reported

to have suffered substantial losses, including 40 cattle deaths, and lowered conception rates, weight gains, calf weaning rates, and milk production. Losses were calculated in financial terms at an average of $20 per head for the total cattle population of the county.

According to Gurba, larval counts on the river before this year's treatments were the highest on record. So methoxychlor probably averted considerable livestock damage.

But what other costs does the use of methoxychlor entail? A 1976 report for the provincial department of recreation, parks and wildlife notes problems of bioaccumulation are likely, since the chemical has been found in the small water insects on which fish feed.

The report adds that the black fly larviciding doses also fall within the range of toxicity to fish. "Long-term laboratory studies have demonstrated reversible pathological effects, growth retardation, and inhibition of spawning and hatching in some fish species."

The report also points to some "unknowns" in the use of methoxychlor which call for further research--for example, its persistence in the river's bedload and sediments, and the way it breaks down.

A report on the experimental program, produced by the Lethbridge researchers and Alberta Environment, is now nearing completion. But the Freshwater Institute in Winnipeg, which had been involved in monitoring the program, has already noted a dramatic increase in the numbers of organisms found dead and drifting downstream once the chemical was introduced into the river.

Depner says he was concerned about the possibility of damage to non-target organisms, but was reassured by the findings of his own program.

"Actually I was very pleased with the lack of destruction of the non-target organisms," he said. "If (methoxychlor treatment) is done properly, I think the damage is acceptable."

Dave Pledger, who is in charge of monitoring the black fly control program for Alberta Environment, adds that, though invertebrates are affected by the chemical, there appears to have been no reduction in the number of families of non-target organisms. "It appears that the river does recover."

And methoxychlor, though a broad-spectrum insecticide, does have one characteristic which recommends it for its present use: it tends to adhere to silt, and black fly larvae filter the silt to feed.

The methoxychlor program does not represent the only work being done on black fly control. Joe Shemanchuk, an entomologist with Agriculture Canada's Lethbridge research station, has been working for almost three years on a project to find a suitable black fly repellent to apply to cattle.

From early experiments with repellents used by humans, a product effective for up to seven days has been found. As it would be applied directly to the animal's skin, environmental damage would be almost completely eliminated.

Results, says Shemanchuk, look "very promising." But the repellent can't yet replace the river treatments.

Nobody feels happy about them.

"I look on the treatment of the river as something we can do now," says Gurba. "But it's certainly not the ideal solution."

"I don't want to see the river treated each year," says Depner. "(But) if it's needed...what can you do?"

Other Ways That Work

Pesticide use is not the only form of pest control.

For as long as weed and insect pests have been around, man has cursed them, tolerated them--or fought them with all the means at his disposal.

When chemical pesticides appeared on the scene, it seemed that the fighting would be over. Now, with increasing concern about environmental effects of such chemicals, the search is on for alternative ways to win the war.

Entomologists, for example, are studying insects to find out how they function in an ecosystem. By trying to establish which insects will eat which weeds or prey on other insects, they work as biological detectives searching for evidence to expose the enemy's weakness.

Dr. W.G. Evans of the University of Alberta's entomology department sees biological control--the use of other organisms to control pests--as the main alternative to chemical pest control. It involves the use of diseases, predators or parasites to kill insects, and of diseases or insects to control weeds.

LAUREN DALE

One of Evans' students is working on a plan to control leafy spurges, whose milky, latex-like sap is poisonous to cattle. The spurges are usually found on range land, and cover an area too big to make the use of herbicides practical or desirable.

The plants had flourished unchallenged since their introduction to North America from Europe years ago because their natural enemies--several varieties of beetle--were left behind.

A scientific group from Edmonton (including Evans' student) went to Europe to examine the plant in its native habitat, and discovered some 15 different kinds of beetle that fed on the spurges. A study is now under way on eight of the beetle types, to determine how effective each species would be at controlling the spurges, and whether they are likely to harm agriculturally important plants here.

OK. A few pointers from this guy and you should be able to wipe out a field of grasshoppers in a flash.

Evans is also co-operating on a project to control thistle.

"This is a real problem in Alberta," he says.

"It's dangerous to cattle, and difficult to control. Furthermore, the cost of spraying would be prohibitive, and even if it were not, it would be unwise to spray grazing land with herbicides."

It was thought that a fly from Europe had some potential as a control, but the first test was a failure; the cattle ate the plants on which the insects were found. Later tests on fields empty of cattle proved more successful.

The same principle of biological control is working well in British Columbia, where the weed St. John's Wort had invaded large areas of range land. A beetle species was introduced which has to date eaten a considerable amount of the weed.

Microbial diseases are another recent means of controlling forest pests, says Evans. Applied just like chemical pesticides in powder form, they are in fact micro-organisms which infect the target pest. One disease is very effective against moths and their larvae--including the notorious spruce bud worm--which cause major forest damage.

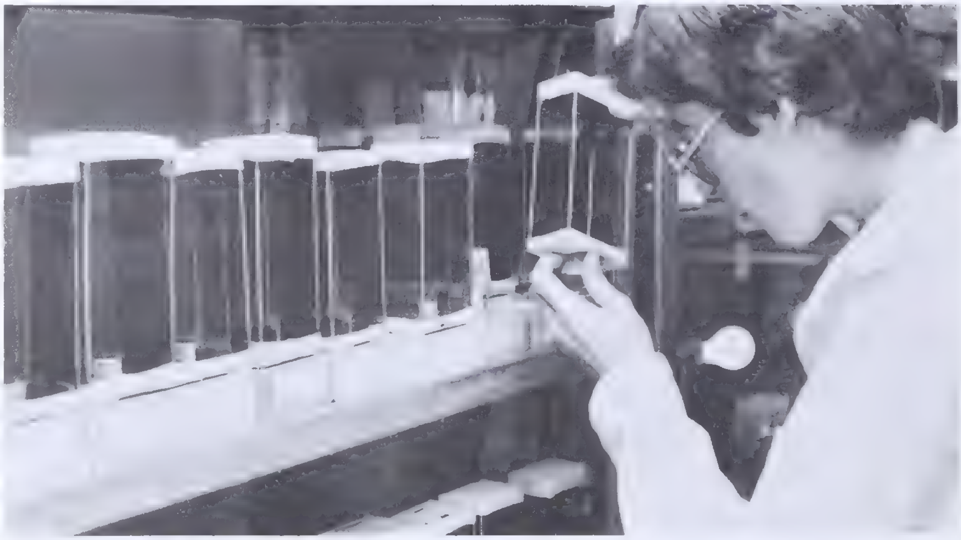
Genetics may also be used in the war against insects.

In 1976, a technologist in the entomology department found a mutant tsetse fly in a colony the department maintained for research. The tsetse fly, which is native to Africa and carries sleeping sickness, normally has dark brown eyes. In the first generation of the mutant strain, however, the eyes are salmon-colored, and in the second generation they are white.

Researchers in the department have discovered that the first generation mutant is much less "viable," or likely to survive--and the mutation in the second generation is fatal; all the white-eyed flies died before being able to reproduce.

In a project funded by the World Health Organization, they are now trying to discover whether the fatal mutant can be introduced into the normal tsetse fly community in sufficient numbers to prevent the normal

The University of Alberta entomology department's tsetse fly research project may result in a biological means to eliminate the pest.



LAUREN DALE

specimens from mating with one another; this could bring about the eventual extinction of the disease-carrying pest.

Other aspects of biological control are being studied at Agriculture Canada's Lethbridge research station. Entomologist Joe Shemanchuk, in collaboration with researchers at the University of Washington in Seattle, is working with a water mould fungus found to be fatal to mosquito larvae. The mould has been found in irrigation areas around Lethbridge.

Dr. Dean Struble, an organic chemist at the station, is studying the use of sex pheromones as a means of controlling insect pests. These are chemicals given off by female insects to attract males.

Struble says a lot of research has been done on the use of sex pheromones to control codling moths in apple orchards. And the way they work is simple: chemists can create synthetic pheromones, which are sprayed around the orchard; the male moths can't distinguish the synthetic from the real pheromones, and so can't locate the females. The result? No breeding, and, hopefully, no more codling moths.

The problem of orchard pests has also been tackled at Simon Fraser University in British Columbia. The University of Alberta's Evans describes one solution developed there: mechanical pest control based on biological principles.

The Simon Fraser researchers had discovered that certain insect pests were extremely vulnerable to disease if they became too damp. So the orchard control system consists of fine mists of water turned on at intervals.

But not all the work on biological control of pests takes place in university laboratories. Dr. D.A. Craig of the University of Alberta entomology department says some amateur organic gardeners have discovered biological control through a "folklore mythology."

They've learned, for example, to collect samples of problem pests, grind them in a food blender and spray the resulting "bug juice" on the garden--often with marked success.

Why does this work? Craig explains that some of the insects collected are likely to be diseased. The grinding and blending process spreads that disease around the garden. "Some of the folklore things have a good basis in science," he says.

More "folklore" surrounds the practice of "companion planting."

Some home gardeners have discovered that planting, say, beets and carrots next to one another results not only in insect-free vegetables, but in bigger and tastier ones too.

Garlic oil is apparently a powerful larvicide and is shunned by almost every insect pest in the garden. Marigolds planted throughout the garden seem to reduce the number of wormy pests.

The key to this mysterious effect may lie in the natural ability of some plants to inhibit weed growth by releasing toxic substances into the soil. Chemicals, especially aromatic ones, released into the air may have a similar effect in repelling insects.

As garden writer Lynn Zimmerman notes in a recent issue of the magazine *Harrowsmith*:

"Companion planting is still very much a backyard science, but there is increasingly solid evidence proving that at least some species of green plants can actually affect or change the environment in which they grow. Instead of the immobile, silent, passive bumps in the garden row you may always have assumed them to be, plants can be aggressive, competitive, active participants in assuring their own survival."

Hmm...needs more caterpillar eyelids.

Perhaps the most crucial battles against pests are fought on the farmer's fields, and

Tillage–a mechanical way to control weeds

it's here that yet another alternative to pesticide use can be employed.

That alternative involves cultural practices--in a sense, the *way* the farmer does his job.

Keith Price, head of Alberta Agriculture's weed control and field services branch, notes that, to some extent, all farmers use cultural methods to control pests.

Delayed seeding, for instance, is a widespread practice. This allows for the appearance of an early growth of wild oats, which can be worked in before the crop is planted. Some weeds can also be controlled by crop rotation, since they'll affect some crops but not others.

But few indeed are the farmers who, when it comes to the crunch, will shun pesticides altogether. In fact, research for this article turned up so few in Alberta that the search was extended to Saskatchewan too.

In that province there's evidence of greater interest in non-chemical means of pest control on the farm; and it's a Saskatchewan "organic farmer" whose methods have recently attained national prominence.

Elmer Laird farms near Davidson, Saskatchewan. He's currently battling the provincial crop insurance authorities, who have so far refused to give him crop insurance coverage because, they say, his farming methods are unsatisfactory.

Laird hasn't used chemicals of any sort on his farm since 1969. That was a year of wheat surpluses, and he had wheat--all duly treated against pests--piled up on his farm.

"I didn't see the point of buying spray to use on more wheat which was also going to pile up," he said.

Reading about the environmental effects of many of the pesticides he was using strengthened his convictions. But for several years, he "didn't do very much" in the way of seeking alternatives to pesticide use.

One of his first steps was to tackle the problem of replenishing his depleted soil, on the assumption that good soil will grow good, strong crops less susceptible to infestation by weeds or insect pests. He began rotating his crops and using clover to fix nitrogen in the soil. Then other cultural practices developed.

Now, he delays seeding to give the weeds a chance to grow first and be worked under. Then he seeds heavier than most other farmers, so that the crop will choke out any weeds that do develop.

He uses a rod-weeder immediately after seeding, and then does some shallow harrowing when the crop is about 10 centimetres high. ("I didn't notice any damage to the crop at all," he notes.)

He's had little trouble with insect pests, but does recall a grasshopper infestation in 1975. His neighbors sprayed to control them, but he didn't--and he found little difference in crop yields. That, he says, is because grasshoppers usually strike in a dry season when crops are poor anyway. The greater harm, he feels, comes from the drought rather than the grasshoppers.

Have Laird's methods paid off economically?

"I probably haven't made as much money as my neighbors," he says. But he's got by, and he's now so convinced of the benefits of "clean" crops that he's no longer even tempted to use pesticides.

Emil Siebold, a Camrose farmer, agrees.

He hasn't used chemicals on his half-section since about 1955, and what he's managed to produce has supported a family of four children comfortably, he says.

He considers his farming practices differ little, in fact, from those of his pesticide-using neighbors--though he feels he probably works his land a little deeper. He also puts half to summer fallow each season.

So far, there have been few problems.

"We have had the odd year with pigweed," he notes. "But they have been dry years and nobody else had crops either."

It seems few farmers are prepared to take Laird's and Siebold's line on pest control, in spite of their apparent success.

"I'm afraid it's always easier to spray... even though it's often difficult to assess the effects of the spray on the organism you are after, and certainly exceedingly difficult to assess it on those you are not after," says the University of Alberta's Evans.

Laird puts the case more bluntly.

"In many cases farm chemicals are an addiction," he says. "I think farmers in the spring get a feeling that if they were cut off chemicals there would be a panic."

Evans sees the problem of the future not in *developing* safe and effective alternatives to chemical pesticides, but in persuading farmers and governments to use them.

Viewpoints

A government critic, and a government spokesman, discuss policy and action on pesticide use.

Dr. David Boag,
Professor of Zoology, University of Alberta.
(Dr. Boag was chairman of the ad hoc biocides committee set up by the Environment Conservation Authority to gather technical data prior to public hearings on pesticide use in the province in 1974.)

In February of 1976, the Environment Conservation Authority (ECA) published a document entitled "The Use of Pesticides and Herbicides in Alberta: Report and Recommendations." This document represented the culmination of the first phase in the public hearing process (the mandate of the ECA) and appeared two years after a series of public hearings that were held throughout the province and that dealt with the whole spectrum of biocide use in Alberta. The second, and equally important phase in the public-hearing process, is the response of goverment to the recommendations made to it, both explicit and implicit.

It is now more than three years since the government received the ECA report and recommendations and, in my opinion, the public is fully justified in asking what tangible evidence there is that the government has acted on its recommendations and produced some manifest changes in response to them.

The public hearings on the use of biocides centred on discussions of the relative "costs" and "benefits" of their use in Alberta. It became apparent that virtually all these commercially-produced chemicals were non-specific in their action, being lethal to a spectrum of species of which the target species was but one. For example, the insecticide introduced into the Athabasca River this summer killed many target organisms (black fly larvae) but it also killed a wide range of other organisms living in the river.

Dr. David Boag

ANDREW VAUGHAN

Because of the nonspecific nature of biocides, public input at the hearings fell generally into one of two categories. On one side were those who saw the use of these chemicals as essential, not only for balancing their budgets but also for providing them with a profit; the "environmental costs" which usually were of no immediate concern to the applier of the biocide and either unknown or difficult to document, were rarely entered on the debit side of their ledgers. The other position was taken by those who believed that it was necessary not only to determine the "environmental costs" but also to enter them annually on the debit side of any ledger.

Many in the latter group, although acknowledging that the "apparent benefits" of the use of these chemicals exceeded the "apparent costs," environmental costs included, nevertheless were not convinced that the "apparent costs" were always the "whole cost." The memory of DDT, the supposed cure-all for all insect pest problems, is still fresh enough to prompt caution.

To reconcile these two opinions, the government had two initial obligations: 1) to produce a policy statement on the government's position vis-à-vis the use of biocides in Alberta, and 2) to establish a fund to undertake research that would answer the many questions raised about the side-effects of present pesticide programs in this province. What has the government done in this regard?

As of the time of writing (Sept. 8, 1979), the province of Alberta remains without any policy statement regarding the use of biocides. It would appear that we must continue to deal with the application of biocides to the environment on a purely ad hoc basis. It is because of this approach that we now have a plethora of Acts and regulations with overlapping jurisdiction to deal with the multitude of these commercially-produced poisons that are continuously being pushed on to the Alberta market by the companies that manufacture them.

The need to sponsor research into the long-term side effects of biocide use remains an important requirement. As yet there has been very little evidence that the government has taken this responsibility to heart. The Alberta government's own scientists have provided scant evidence to alleviate public concerns in this direction. For example, the government's insecticide-black fly investigation in the Athabasca River has, after three years, produced no report for public scrutiny. The only published data has come from the Freshwater Institute in Winnipeg and it indicates that the insecticide used produced a "catastrophic drift" (enormous peak in the numbers of dead organisms drifting downstream following introduction of the chemical) for the distance monitored (400 km). To date the government appears to have been unreceptive to requests for research support into pest problems other than those that deal with efficacy testing on target organisms. This is not the sort of research that is needed to allay fears of environmental side-effects.

If the public hearing process is to function in providing critical input to the development or change of government policy, then it is imperative that those contributing to public hearings not look upon the exercise with cynicism. Such an attitude can only be avoided by a government response that is not only significant but also highly visible. To date, the evidence of such a response by the government of Alberta to the use of biocides in this province has not been manifest.

Eugene Kupchanko,
Assistant Deputy Minister,
Environment Protection Services,
Alberta Environment.

Since 1976, Alberta Environment has broadened and intensified its pesticide management program in Alberta. Many of these activities are in direct response to the recommendations by the Environment Conservation Authority, and include:

a. The establishment of regional inspection and enforcement offices in Grande Prairie, Edmonton, Calgary and Lethbridge. Staff in these offices not only carry out inspections and enforce the Act, but also investigate problems, and do extension work in these regions.

b. A full-time training officer has been established to improve and increase training programs and extension materials. New and more selective training courses have been developed for pesticide applicators; a home study course has been developed for pesticide dealers. The home study course for applicators offered by Lakeland College has been updated with our co-operation, and a monthly newsletter is now distributed.

c. The Agricultural Chemicals Act was amended on May 17, 1978, to support the intensified pesticide management program. Amendments include pesticide vendor licensing, increased restrictions for certain compounds, more protection for water bodies, and an improved reporting system for accidental spills. New, supporting regulations have been prepared and are now awaiting cabinet approval.

Eugene Kupchanko

d. The monitoring and technical assistance for municipal mosquito abatement programs has been increased and intensified.

e. An environmental impact monitoring program has been established in relation to chemical use in aquatic habitats, forest, and range management.

Pesticide research programs are planned for the Alberta Environmental Centre at Vegreville. The plant sciences wing of the centre will conduct or support a variety of studies involving pesticide chemicals. These will include environmental and biological impact studies, both long-term and short-term, as well as systems of integrated pest management to lessen our dependency on chemical control. Other studies will be more specific, dealing with definite pest problems in Alberta.

The department has developed a written government policy with respect to chemical pesticides. These policy statements cover all aspects of pesticide use in Alberta and were approved by the Minister in September.

Government response to some of the more specific recommendations in the 1976 Environment Conservation Authority report include:

Screening of Mutagenic Chemicals

Agriculture Canada requires mutagenicity studies (studies to determine whether genetic changes are produced) prior to registration of pesticide chemicals in Canada. They also withdraw previously registered compounds from the market if later studies indicate a possibility of mutagenic effects. Our department works closely with the federal authorities in follow-up response to these studies or findings.

Freedom of Information

Alberta Environment has fully supported

the principle of freedom of information where it concerns health and environmental hazards. We have made much of this type of information available to the public through reports, news releases, and newsletters.

Course in Environmental Health

A medical consultant is under contract to the department to deal specifically with the human health effects of pesticide chemicals. He is presently investigating the possibility of disseminating this type of information to the medical profession in Alberta.

Categorization and Control of Toxic Chemicals

The categorization of pesticide chemicals will be included in new regulations. These new regulations will also spell out various restrictions for the use of these pesticides. We have also passed the Hazardous Chemicals Act 1978, which will control hazardous chemicals not covered by the Agricultural Chemicals Act.

Vertebrate Poisons

Since 1976, thallium sulfate has been withdrawn, and strychnine more restricted federally. Other vertebrate poisons will be restricted under amendments to regulations under the Agricultural Chemicals Act. The Pharmaceutical Association of Alberta has agreed to delete strychnine from its schedules and leave control to our department.

Efficacy Testing

All compounds presently used in mosquito-abatement programs are tested by the department. Other control products will be screened at the Alberta Environmental Centre. This is also a normal registration requirement by Agriculture Canada.

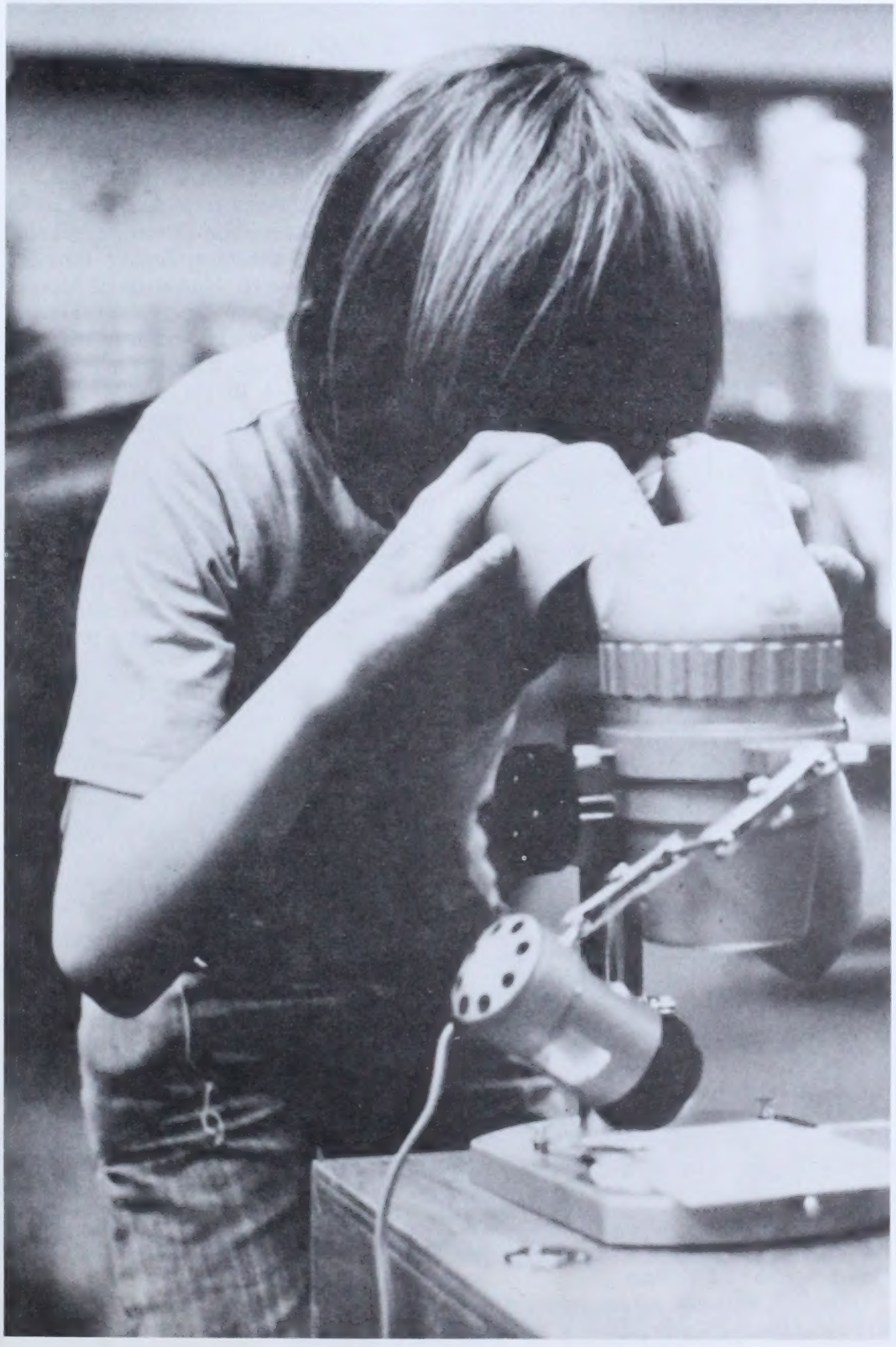
Control Over Sales of Toxic Chemicals to Householders

Proposed regulations will restrict the sales of highly toxic materials to permit holders or licensed applicators. Retailers selling to householders will be licensed and trained so that information pertaining to health and environmental hazards may be passed along to their customers.

Control Over Avicides

Chemicals registered as avicides (which kill

Sampling from a slough as part of the pesticides monitoring program.



Young participant at a shopping mall presentation on pesticides mounted by Alberta Environment.

birds) will be scheduled under proposed regulations, and their use restricted to permit holders or licensed applicators.

Emphasis on Mechanical Clearing of Rights-of-Way

Rights-of-way in Alberta are presently cleared by mechanical means. Maintenance, however, is by both mechanical and chemical means. The department has actively supported research into revegetation of rights-of-way to grasses so that chemical maintenance is unnecessary. New regulations will require permits for chemical control of rights-of-way vegetation in the Green Zone of the province.

Training of Aerial Spray Applicators

All aerial pesticide applicators are trained and must write an examination before receiving a licence from the department. Courses are offered both at Olds Regional College and Lakeland College at Vermilion. Furthermore, previously trained aerial applicators must attend a refresher course every three years.

Our intensified pest management program has gone beyond the recommendations in the 1976 Environment Conservation Authority report in many areas not cited above. Some of these include:

1. More specific training courses for pesticide applicators and vendors.

2. Increased extension services including participation at meetings of user groups, as well as presentations at universities, colleges, and technical and public schools.

3. Increased liaison with agencies from all levels of government including other provincial governments.

4. Increased monitoring of food, feeds, soil, and water for pesticide residues.

5. Increased surveillance over spray programs within the province.

6. Programs to encourage proper disposal of pesticide containers. One present program involves the removal of all such containers from water drainage areas in southern Alberta.

7. Intensified inspection of storage and transport facilities.

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Environment Update

Pipeline Panel's Work Ends

The Alaska Highway pipeline panel, set up in 1976 to consider overall environmental and socioeconomic impacts of the proposed pipeline and associated activities, has wound up its activities.

The panel was funded by Foothills Pipelines Ltd., a company seeking to build the pipeline, but worked independently of the company.

Panel chairman Carson Templeton notes that some of the panel's findings could be considered highly unfavorable to Foothills. Its concerns, for example, about the company's inexperience of construction on permafrost have recently been echoed by the federal environment department's environmental assessment panel.

But Templeton considers such difficulties are "not insurmountable" (though Foothills has now in fact withdrawn its application to build the pipeline). He adds:

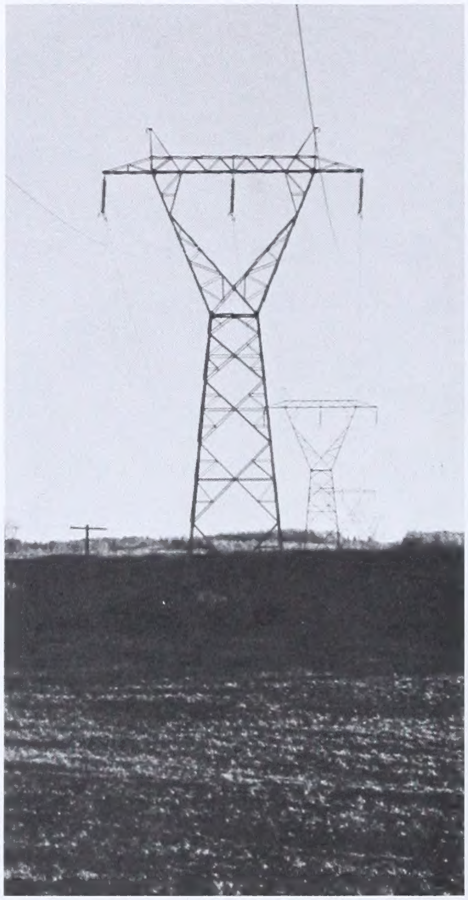
"We have pioneered quite a long way in the last year in the impact assessment process, in taking a look at the overall picture, not just a gas pipeline, and (putting conclusions) into a form that the decision-makers can understand."

Citizens Join In Review

Cold Lake area residents are to help review the Environmental Impact Assessment (EIA) carried out by Esso Resources on its proposed Cold Lake heavy oil project.

Alberta Environment has asked the community advisory committee to take part in the review, the first to be held publicly on an EIA.

Once approved, the EIA will provide additional information to the cabinet committee responsible for making the final decision on the project. The Energy Resources Conservation Board has already given the project preliminary approval.


ANDREW VAUGHAN

Transmission Line Hearings Start

Public hearings started in Calgary on Oct. 9 into the application by Calgary Power to build a 500-kilovolt transmission line from a new sub-station at Langdon, near Calgary, to Phillips Pass on the B.C. border.

The company is proposing three alternative routes, all across agricultural land.

The purpose of the line would be to connect the Alberta and B.C. power grids. Approval has already been given to the B.C. part of the connection, from a site near Cranbrook to Phillips Pass.

Hearings were also scheduled for High River and Pincher Creek.

Committee To Study Hazardous Wastes

Environment minister Jack Cookson has appointed a management committee to study dangerous chemical disposal in Alberta.

Committee members include Fort Saskatchewan farmer John Devereux, Alberta Environment assistant deputy minister Eugene Kupchanko, University of Alberta chemistry professor Dr. Walter Harris, Murdo MacKenzie, a captain in the Calgary fire department, Alberta Environment sociologist Frank Belyea, and Ken Simpson, head of the department's waste management branch.

The committee's appointment follows a proposal by the firm Kinetic Contaminants Canada Ltd. to establish a hazardous waste disposal site near Fort Saskatchewan.

The Environment Council of Alberta will hold public hearings on the committee's recommendations and submit a report to Cookson by mid-1980. There will be a moratorium on hazardous waste disposa in the province until then.

Environment Pamphlets Available

The University of Alberta student legal services have produced a series of three "self-help" pamphlets on environmental concerns.

The publications are "Environmenta Cope Kit: a citizen's guide to public participation," "Water Pollution: a citizen' guide to Alberta legislation," and "Ai Pollution: a citizen's guide to Alberta legislation."

Copies of the pamphlets may be obtaine from:

Legal Reform Project,
Student Legal Services,
114 Law Centre,
University of Alberta,
Edmonton, Alberta
T6G 2H5
Telephone: 432-2226

B44512